

Appendix A: Detailed Economic Impact Analysis Information

INTRODUCTION

This appendix provides information to support the economic analyses of MP&M industries evaluated for the final rule and presented in Chapter 3 through Chapter 11 of the EEBA. The first section below provides the SIC and NAICS codes that define the MP&M industrial sectors. The second section presents information on the annual turnover of establishments (“births” and “deaths”) in the industrial sectors. The third section provides a description of the MP&M surveys that supported the economic impact and benefits analyses presented in the EEBA (see Section 3 of the TDD).

A.1 MP&M SIC AND NAICS CODES

Standard Industrial Classification (SIC) codes and North American Industrial Classification System (NAICS) codes are hierarchical systems that allow for detailed classification of industries using numerical codes. This section lists and describes the SIC codes that make up the MP&M industry sectors. It also describes the process by which data organized by NAICS code was converted to SIC code format.

A.1.1 SIC Codes by Sector

Table A.1 lists and describes the 4-digit SIC codes that make up the MP&M industry sectors. These codes were used until recently to define industries for reporting of Federal Census data, and are the framework for the part of the industry profile (Chapter 3) based on publicly available material.

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Table A.1: MP&M Sectors and SIC Codes Evaluated for the Final Rule ^a	
SIC Code	Standard Industrial Classification Groups
<i>Aerospace</i>	
3761	Guided Missiles and Space Vehicles
3764	Guided Missile and Space Vehicle Propulsion
3769	Other Space Vehicle and Missile Parts
<i>Aircraft</i>	
3721	Aircraft
3724	Aircraft Engines and Engine Parts
3728	Aircraft Parts and Auxiliary Equipment
4581	Airports, Flying Fields, Airport Terminal Services
<i>Bus And Truck</i>	
3713	Truck and Bus Bodies
3715	Truck Trailers

Table A.1: MP&M Sectors and SIC Codes Evaluated for the Final Rule^a

SIC Code	Standard Industrial Classification Groups
4111	Local And Suburban Transit
4119	Local Passenger Transit, N.E.C.
4131	Intercity And Rural Bus Transportation
4141	Local Bus Charter Service
4142	Bus Charter Service, Except Local
4173	Bus Terminal And Service Facilities
4212	Local Trucking without Storage
4213	Trucking, Except Local
4214	Local Trucking with Storage
4215	Courier Services, Except by Air
4231	Trucking Terminal Facilities
<i>Electronic Equipment</i>	
3661	Telephone and Telegraph Apparatus
3663	Radio and Television Broadcast and Communications Equipment
3669	Communications Equipment, N.E.C.
3671	Electron Tubes
3675	Electronic Capacitors
3677	Electronic Coils and Transformers
3678	Connectors for Electronic Applications
3679	Electronic Components, N.E.C.
3699	Electrical Machinery, Equipment, And Supplies, N.E.C.
<i>Hardware</i>	
2796	Platemaking and Related Services
3398	Metal Heat Treating
3412	Metal Shipping Barrels, Drums, Kegs, Pails
3421	Cutlery
3423	Hand And Edge Tools, Except Machine Tools and Handsaws
3425	Hand Saws and Saw Blades
3429	Hardware, N.E.C.
3433	Heating Equipment, Except Electric and Warm Air Furnace
3441	Fabricated Structural Metal
3443	Fabricated Plate Work (Boiler Shops)
3444	Sheet Metal Work
3446	Architectural and Ornamental Metal Work
3448	Prefabricated Metal Buildings And Components
3449	Miscellaneous Metal Work
3451	Screw Machine Products
3452	Bolts, Nuts, Screws, Rivets, and Washers
3462	Iron and Steel Forgings
3466	Crowns and Closures
3469	Metal Stamping, N.E.C.
3492	Fluid Power Valves and Hose Fittings
3493	Steel Springs
3494	Valves And Pipe Fittings, Except Brass

Table A.1: MP&M Sectors and SIC Codes Evaluated for the Final Rule^a

SIC Code	Standard Industrial Classification Groups
3495	Wire Springs
3496	Miscellaneous Fabricated Wire Products
3498	Fabricated Pipe and Fabricated Pipe Fitting
3499	Fabricated Metal Products, N.E.C.
3541	Machine Tools, Metal Cutting Types
3542	Machine Tools, Metal Forming Types
3544	Special Dies and Tools, Die Sets, Jigs and Fixtures, and Industrial Molds
3545	Machine Tool Access and Measuring Devices
3546	Power Driven Hand Tools
3965	Fasteners, Buttons, Needles, Pins
<i>Household Equipment</i>	
2514	Metal Household Furniture
2522	Office Furniture, Except Wood
2531	Public Building and Related Furniture
2542	Partitions and Fixtures, Except Wood
2591	Drapery Hardware and Window Blinds/shades
2599	Furniture and Fixtures, N.E.C.
3431	Metal Sanitary Ware
3432	Plumbing Fittings and Brass Goods
3442	Metal Doors, Sash, and Trim
3631	Household Cooking Equipment
3632	Household Refrigerators and Home and Farm and Freezers
3633	Household Laundry Equipment
3634	Electric Housewares and Fans
3635	Household Vacuum Cleaners
3639	Household Appliances, N.E.C.
3641	Electric Lamps
3643	Current-carrying Wiring Devices
3644	Noncurrent-carrying Wiring Devices
3645	Residential Electrical Lighting Fixtures
3646	Commercial, Industrial, and Institutional
3648	Lighting Equipment, N.E.C.
3651	Radio/television Sets Except Communication Types
7623	Refrigeration and Air-conditioning Service and Repair Shops
<i>Instruments</i>	
3812	Search, Detection, Navigation, Guidance, Aeronautical, Nautical Systems and Instruments
3821	Laboratory Apparatus and Furniture
3822	Automatic Environmental Controls
3823	Process Control Instruments
3824	Fluid Meters and Counting Devices
3825	Instruments to Measure Electricity
3826	Laboratory Analytical Instruments
3827	Optical Instruments and Lenses
3829	Measuring and Controlling Devices, N.E.C.

Table A.1: MP&M Sectors and SIC Codes Evaluated for the Final Rule^a

SIC Code	Standard Industrial Classification Groups
3841	Surgical and Medical Instruments and Apparatus
3842	Orthopedic, Prosthetic and Surgical Suppl.
3843	Dental Equipment and Supplies
3844	X-ray Apparatus and Tubes
3845	Electromedical Equipment
3851	Ophthalmic Goods
7629	Electric Repair Shop
<i>Iron and Steel</i>	
3315	Steel Wiredrawing and Steel Nails and Spikes
3316	Cold-Rolled Steel Sheet, Strip, and Bars
3317	Steel Pipe and Tubes
<i>Job Shop</i>	
3471	Plating and Polishing
3479	Metal Coating and Allied Services
<i>Mobile Industrial Equipment</i>	
3523	Farm Machinery and Equipment
3524	Garden Tractors and Lawn and Garden Equipment
3531	Construction Machinery and Equipment
3532	Mining Machinery and Equipment, Except Oil Field
3536	Hoists, Industrial Cranes and Monorails
3537	Industrial Trucks, Tractors, Trailers
3795	Tanks and Tank Components
<i>Motor Vehicle</i>	
3465	Automotive Stampings
3592	Carburetors, Piston Rings, Valves
3647	Vehicular Lighting Equipment
3694	Electrical Equipment for Motor Vehicles
3711	Motor Vehicle and Automobile Bodies
3714	Motor Vehicle Parts and Accessories
3716	Mobile Homes
3751	Motorcycles
3792	Travel Trailers and Campers
3799	Miscellaneous Transportation Equipment
4121	Taxicabs
5013	Motor Vehicle Supplies and New Parts
5511	Motor Vehicle Dealers (New and Used)
5521	Motor Vehicle Dealers (Used Only)
5561	Recreational Vehicle Dealers
5571	Motorcycle Dealers
5599	Automotive Dealers, N.E.C.
7514	Passenger Car Rental
7515	Passenger Car Lease
7519	Utility Trailer and Recreational Vehicle Rental
7532	Top, Body, and Upholstery Repair and Paint Shops

Table A.1: MP&M Sectors and SIC Codes Evaluated for the Final Rule^a

SIC Code	Standard Industrial Classification Groups
7533	Auto Exhaust Systems
7537	Auto Transmission Repair
7538	General Automotive Repair
7539	Auto Repair Shop, N.E.C.
7549	Auto Services, Except Repair and Carwashes
<i>Office Machine</i>	
3571	Electronic Computers
3572	Typewriters
3575	Computer Terminals
3577	Computer Peripheral Equipment, N.E.C.
3578	Calculating, Accounting Machines Except Computers
3579	Office Machines, N.E.C.
7378	Computer Maintenance and Repairs
7379	Computer Related Services, N.E.C.
<i>Ordnance</i>	
3482	Small Arms Ammunition
3483	Ammunition, Except for Small Arms
3484	Small Arms
3489	Ordnance and Accessories, N.E.C.
<i>Miscellaneous Metal Products</i>	
3497	Metal Foil and Leaf
3861	Photographic Equipment and Supplies
3931	Musical Instruments
3944	Games, Toys, Children's Vehicles
3949	Sporting and Athletic Goods, N.E.C.
3951	Pens and Mechanical Pencils
3953	Marking Devices
3993	Signs and Advertising Displays
3995	Burial Caskets
3999	Manufacturing Industries, N.E.C.
7692	Welding Repair
7699	Repair Shop, Related Service
<i>Precious Metals and Jewelry</i>	
3873	Watches, Clocks, and Watchcases
3911	Jewelry, Precious Metal
3914	Silverware, Plated Ware and Stainless
3915	Jewelers' Materials and Lapidary Work
3961	Costume Jewelry
7631	Watch, Clock, Jewelry Repair
<i>Printed Circuit Boards</i>	
3672	Printed Circuit Boards
<i>Railroad</i>	
3743	Railcars, Railway Systems
4011	Railroad Transportation

Table A.1: MP&M Sectors and SIC Codes Evaluated for the Final Rule^a

SIC Code	Standard Industrial Classification Groups
4013	Railroad Transportation
<i>Ships and Boats</i>	
3731	Ship Building and Repairing
3732	Boat Building and Repairing
4412	Deep Sea Foreign Transportation
4424	Deep Sea Domestic Transportation
4432	Freight Transportation Great Lakes
4449	Water Transportation of Freight, N.E.C.
4481	Deep Sea Passenger Transportation
4482	Ferries
4489	Water Passenger Transportation, N.E.C.
4491	Marine Cargo Handling
4492	Towing and Tugboat Service
4493	Marinas
4499	Water Transportation Services, N.E.C.
<i>Stationary Industrial Equipment</i>	
3511	Steam, Gas, Hydraulic Turbines, Generating Units
3519	Internal Combustion Engines, N.E.C.
3533	Oil Field Machinery and Equipment
3534	Elevators and Moving Stairways
3535	Conveyors and Conveying Equipment
3543	Industrial Patterns
3547	Rolling Mill Machinery and Equipment
3548	Electric and Gas Welding and Soldering
3549	Metal Working Machinery, N.E.C.
3552	Textile Machinery
3553	Woodworking Machinery
3554	Paper Industries Machinery
3555	Printing Trades Machinery and Equipment
3556	Food Products Machinery
3559	Special Industry Machinery, N.E.C.
3561	Pumps and Pumping Equipment
3562	Ball and Roller Bearings
3563	Air and Gas Compressors
3564	Blowers and Exhaust and Ventilation Fans
3565	Industrial Patterns
3566	Speed Changers, High Speed Drivers and Gears
3567	Industrial Process Furnaces and Ovens
3568	Mechanical Power Transmission Equipment, N.E.C.
3569	General Industrial Machinery, N.E.C.
3581	Automatic Merchandising Machines
3582	Commercial Laundry Equipment
3585	Refrigeration and Air and Heating Equipment
3586	Measuring and Dispensing Pumps

Table A.1: MP&M Sectors and SIC Codes Evaluated for the Final Rule^a

SIC Code	Standard Industrial Classification Groups
3589	Service Industry Machines, N.E.C.
3593	Fluid Power Cylinders and Actuators
3594	Fluid Power Pumps and Motors
3596	Scales and Balances, Except Laboratory
3599	Machinery, Except Electrical, N.E.C.
3612	Transformers
3613	Switchgear and Switchboard Apparatus
3621	Motors and Generators
3629	Electric Industrial Apparatus, N.E.C.
7353	Heavy Construction Equip Rental, Leasing
7359	Equipment Rental, Leasing, N.E.C.

^a EPA evaluated options for these industrial sectors but did not regulate them all under the final rule.

N.E.C. = Not Elsewhere Classified

Source: Executive Office of the President, Office of Management and Budget, Standard Industrial Classification Manual 1987.

A.1.2 Bridge Between NAICS and SIC codes

In 1997, the Census Bureau switched from using SIC codes to using NAICS codes. NAICS codes allow for greater comparability with the International Standard Industrial Classification System (ISIC), which is developed and maintained by the United Nations. NAICS codes also better reflect the structure of today's economy, including the growth of the service sectors and new technologies, than do the decades-old SIC codes. Because EPA chose to create regulatory subgroups for the MP&M industries based on aggregated four-digit SIC codes, it was necessary for EPA to convert some data based on NAICS codes into SIC code format.

The SIC-NAICS conversion is not always straightforward because NAICS and SIC codes often don't map on a one-to-one basis. Specific industries that were grouped together in one SIC code sometimes map to several NAICS codes, and sometimes several SIC codes were aggregated together in one NAICS code.

To address this conversion problem, EPA created a "bridge" that converts the NAICS classification structure to the SIC structure using share values computed from Economic Census data. This bridge is based on data from the 1997 Census, which reported the share of number of establishments and value of output that each SIC code that contributed to each NAICS code, and vice versa.

The first step in creating the bridge was to obtain a table that listed the value of shipments (VOS) that each NAICS code contributed to each SIC code. Since the total VOS for each NAICS code was known, EPA computed share values for each NAICS, which were equal to the percent of total VOS in that NAICS code that was classified in a certain SIC code. The equation is:

$$\text{Share of NAICS}_x \text{ going to SIC}_y = (\text{VOS that NAICS}_x \text{ contributed to SIC}_y) / (\text{total VOS for NAICS}_x) \quad (\text{A-1})$$

Using these share values, EPA converted data classified by NAICS to SIC format, simply by multiplying VOS for each NAICS by its share value, for each SIC, and then summing up the totals for each SIC. For example, if NAICS codes 333121, 332456, and 332457 all contributed a portion of their output to SIC 3322, then:

$$\begin{aligned} \text{VOS for SIC}_{3322} = & (\text{share of NAICS}_{333121} \text{ going to SIC}_{3322}) * (\text{VOS for NAICS}_{333121}) \\ & + (\text{share of NAICS}_{332456} \text{ going to SIC}_{3322}) * (\text{VOS for NAICS}_{332456}) \\ & + (\text{share of NAICS}_{332457} \text{ going to SIC}_{3322}) * (\text{VOS for NAICS}_{332457}) \end{aligned} \quad (\text{A-2})$$

Occasionally it was not possible to compute share values because the Census Bureau withheld some 1997 VOS data because of disclosure issues¹. In those cases, EPA estimated 1997 VOS based on 1992 Census data and then used those estimates to compute share values. First, EPA calculated the average VOS per establishment in 1992 for each relevant SIC code:

$$\text{VOS per establishment for SIC}_y = \frac{(\text{VOS for SIC}_y \text{ in 1992})}{(\text{number of establishments for SIC}_y \text{ in 1992})} \quad (\text{A-3})$$

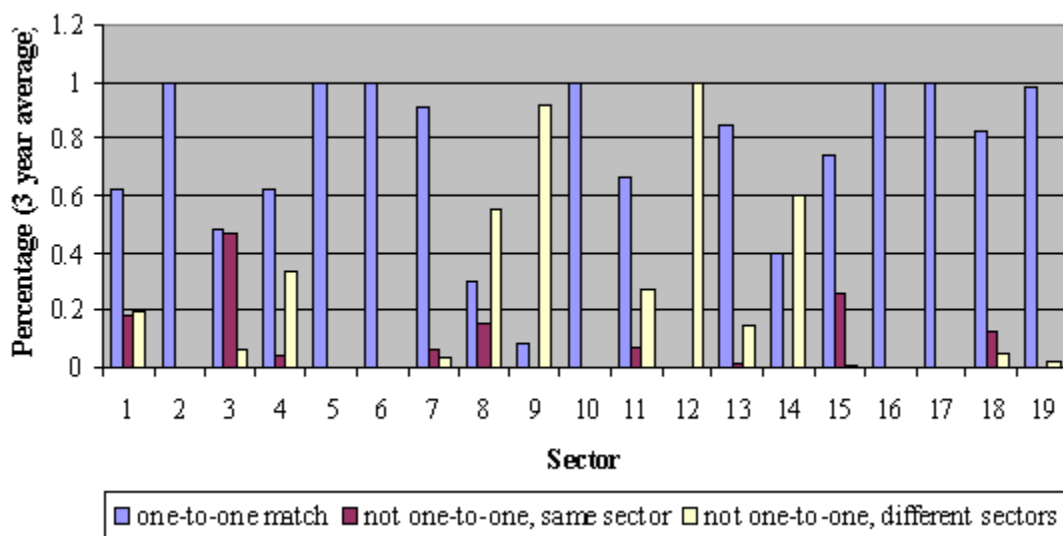
EPA then multiplied this average VOS per establishment for a certain SIC by the number of establishments that each NAICS contributed to that SIC in 1997:

$$\text{Estimated VOS that NAICS}_x \text{ contributed to SIC}_y \text{ in 1997} = (\text{VOS per establishment for SIC}_y) * (\text{number of establishments NAICS}_x \text{ contributed to SIC}_y \text{ in 1997}) \quad (\text{A-4})$$

EPA used this estimated VOS to compute an estimated share value.

To gain a rough measure of how accurately the NAICS codes could be broken into sectors, EPA calculated, by sector: (1) the percentage of NAICS codes that matched “one-to-one” with an SIC code, (2) the percentage that did not match one-to-one but were contained in a single sector, and (3) the percentage that didn’t match one to one and were contained in multiple sectors (Figure A.1, Table A.2).

Figure A.1: Percentage of VOS 1997 to 1999 Attributable to One-to-One NAICS-SIC Match, Not One-to-One but in the Same Sector, and Not One-to-One but in Different Sectors



Sectors: 1 Hardware; 2 Aircraft; 3 Electronic Equipment; 4 Stationary Industrial Equipment; 5 Ordnance; 6 Aerospace; 7 Mobile Industrial Equipment; 8 Instruments; 9 Precious Metals and Jewelry; 10 Ships and Boats; 11 Household Equipment; 12 Railroad; 13 Motor Vehicle; 14 Bus and Truck; 15 Office Machine; 16 Printed Circuit Boards; 17 Job Shop; 18 Miscellaneous Metal Products; 19 Iron and Steel

Source: Department of Commerce, Bureau of the Census, Manufacturing Industry Series; U.S. EPA analysis.

¹ The Bureau of the Census does not release any data that could reveal data about a specific firm. In cases when a NAICS or SIC code is so specific that it includes only a few firms, information about VOS is not released. However, the number of establishments in a specific industry is not considered private information.

Table A.2: Percentage of Input One-to-One, Not One-to-One but in the Same Sector, and Not One-to-One and in Different Sectors						
Sector	VOS One-to-One	Employment One-to-One	VOS Same Sector	Employment Same Sector	VOS Different Sectors	Employment Different Sectors
YEAR: 1997						
1	62.5%	64.3%	18.2%	16.5%	19.3%	19.2%
2	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%
3	46.7%	47.2%	47.2%	43.2%	6.2%	9.7%
4	63.3%	68.1%	3.9%	4.4%	32.8%	27.6%
5	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%
6	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%
7	91.8%	88.1%	5.5%	7.8%	2.7%	4.1%
8	30.4%	30.2%	14.4%	14.4%	55.2%	55.4%
9	10.2%	8.3%	0.0%	0.0%	89.8%	91.7%
10	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%
11	67.5%	60.6%	6.3%	4.5%	26.3%	34.9%
12	0.0%	0.0%	0.0%	0.0%	100.0%	100.0%
13	85.3%	69.5%	1.1%	3.1%	13.6%	27.4%
14	39.1%	42.8%	0.0%	0.0%	60.9%	57.2%
15	73.1%	59.9%	26.4%	38.6%	0.5%	1.5%
16	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%
17	99.9%	99.9%	0.0%	0.0%	0.1%	0.1%
18	83.1%	76.5%	12.2%	17.8%	4.6%	5.7%
19	98.1%	95.3%	0.0%	0.0%	1.9%	4.7%
YEAR: 1998						
1	62.8%	64.9%	17.9%	16.3%	19.3%	18.8%
2	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%
3	47.6%	47.3%	46.0%	42.7%	6.4%	10.0%
4	62.0%	68.3%	3.8%	4.4%	34.2%	27.3%
5	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%
6	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%
7	91.8%	88.0%	5.5%	8.0%	2.7%	4.1%
8	29.4%	29.3%	15.1%	14.7%	55.5%	55.9%
9	8.4%	8.7%	0.0%	0.0%	91.6%	91.3%
10	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%
11	66.2%	60.0%	6.9%	4.8%	26.9%	35.2%
12	0.0%	0.0%	0.0%	0.0%	100.0%	100.0%
13	84.2%	68.0%	1.3%	3.4%	14.6%	28.6%
14	40.7%	43.4%	0.0%	0.0%	59.3%	56.6%
15	73.5%	58.9%	26.0%	39.7%	0.5%	1.4%
16	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%
17	99.9%	99.9%	0.0%	0.0%	0.1%	0.1%
18	82.1%	76.1%	12.9%	18.2%	4.9%	5.8%
19	97.9%	95.3%	0.0%	0.0%	2.1%	4.7%

Table A.2: Percentage of Input One-to-One, Not One-to-One but in the Same Sector, and Not One-to-One and in Different Sectors

Sector	VOS One-to-One	Employment One-to-One	VOS Same Sector	Employment Same Sector	VOS Different Sectors	Employment Different Sectors
YEAR: 1999						
1	62.3%	64.3%	18.3%	16.4%	19.4%	19.3%
2	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%
3	48.7%	47.9%	45.4%	42.3%	5.9%	9.8%
4	61.6%	67.8%	3.6%	4.3%	34.7%	27.9%
5	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%
6	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%
7	89.6%	87.0%	7.4%	8.8%	3.0%	4.2%
8	29.9%	29.8%	15.2%	15.2%	54.9%	55.1%
9	7.1%	7.5%	0.0%	0.0%	92.9%	92.5%
10	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%
11	65.5%	57.8%	7.7%	5.4%	26.9%	36.8%
12	0.0%	0.0%	0.0%	0.0%	100.0%	100.0%
13	84.6%	68.3%	1.3%	3.9%	14.1%	27.9%
14	40.5%	45.8%	0.0%	0.0%	59.5%	54.2%
15	75.6%	56.6%	23.8%	41.9%	0.6%	1.6%
16	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%
17	99.9%	99.9%	0.0%	0.0%	0.1%	0.1%
18	82.0%	76.8%	13.0%	17.1%	5.0%	6.1%
19	97.7%	95.0%	0.0%	0.0%	2.3%	5.0%

Sectors: 1 Hardware; 2 Aircraft; 3 Electronic Equipment; 4 Stationary Industrial Equipment; 5 Ordnance; 6 Aerospace; 7 Mobile Industrial Equipment; 8 Instruments; 9 Precious Metals and Jewelry; 10 Ships and Boats; 11 Household Equipment; 12 Railroad; 13 Motor Vehicle; 14 Bus and Truck; 15 Office Machine; 16 Printed Circuit Boards; 17 Job Shop; 18 Miscellaneous Metal Products; 19 Iron and Steel

Source: Department of Commerce, Bureau of the Census, Manufacturing Industry Series; U.S. EPA analysis.

Table A.3 presents the data that was used to calculate the relationship between NAICS and SIC codes. The table lists the MP&M sector to which each SIC code belongs, gives a short description of each SIC, and lists NAICS codes that encompass similar industries. The table also lists the number of establishments, the value of shipments, and the number of employees that are contributed to each SIC by each NAICS, as well as the share values, i.e. the portion of its total value of shipments that a given NAICS code contributes to a given SIC code.

Table A.3: Relationships between SIC and NAICS Codes Based on 1997 Economic Census for MP&M Industries Evaluated for the Final Rule^a
(thousands, 1997\$)

SIC	SIC Industry	NAICS Code	1997 NAICS Industry	Number of Establishments	Sales, Shipments or Receipts	Share Value
Aerospace						
3761	Guided Missiles and Space Vehicles	336414	Guided Missile and Space Vehicle Manufacturing	22	14,791,466	100.0%
3764	Guided Missile and Space Vehicle Propulsion	336415	Guided Missile and Space Vehicle Propulsion Unit and Propulsion Unit Parts Manufacturing	28	3,239,033	100.0%
3769	Other Space Vehicle and Missile Parts	336419	Other Guided Missile and Space Vehicle Parts and Auxiliary Equipment Manufacturing	49	898,758	100.0%
Aircraft						
3721	Aircraft	336411	Aircraft Manufacturing	204	56,273,651	100.0%
3724	Aircraft Engines and Engine Parts	336412	Aircraft Engine and Engine Parts Manufacturing	369	22,617,284	100.0%
3728	Aircraft Parts and Auxiliary Equipment	336413	Other Aircraft Parts and Auxiliary Equipment Manufacturing	1,138	20,073,061	100.0%
4581	Airports, Flying Fields, Airport Terminal Services	488111	Air Traffic Control	114	43,450	100.0%
		488119	Other Airport Operations	1,699	3,243,149	99.8%
		488190	Other Support Activities for Air Transportation	2,400	5,859,631	100.0%
		561720	Janitorial Services	127	203,918	1.0%
Bus & Truck						
3713	Truck and Bus Bodies	336211	Motor Vehicle Body Manufacturing	715	8,719,326	96.2%
3715	Truck Trailers	336212	Truck Trailer Manufacturing	390	5,507,768	100.0%
4111	Local And Suburban Transit	485111	Mixed Mode Transit Systems	28	51,567	100.0%
		485113	Bus and Other Motor Vehicle Transit Systems	542	1,152,525	100.0%
		485999	All Other Transit and Ground Passenger Transportation	534	601,988	89.9%
4119	Local Passenger Transit, N.E.C.	485320	Limousine Service	3,234	1,873,924	100.0%
		485410	School and Employee Bus Transportation	158	158,947	3.6%
		485991	Special Needs Transportation	1,789	1,141,413	100.0%
		485999	All Other Transit and Ground Passenger Transportation	232	67,395	10.1%
		487110	Scenic and Sightseeing Transportation, Land	307	462,186	82.9%
		621910	Ambulance Services	3,275	4,443,174	88.4%
4131	Intercity And Rural Bus Transportation	485210	Interurban and Rural Bus Transportation	407	1,147,432	100.0%
4141	Local Bus Charter Service	485510	Charter Bus Industry	482	459,953	26.0%
4142	Bus Charter Service, Except Local	485510	Charter Bus Industry	1,049	1,308,246	74.0%
4173	Bus Terminal And Service Facilities	488490	Other Support Activities for Road Transportation	26	15,253	3.9%

Table A.3: Relationships between SIC and NAICS Codes Based on 1997 Economic Census for MP&M Industries Evaluated for the Final Rule^a
(thousands, 1997\$)

SIC	SIC Industry	NAICS Code	1997 NAICS Industry	Number of Establishments	Sales, Shipments or Receipts	Share Value
4212	Local Trucking without Storage	484110	General Freight Trucking, Local	14,545	11,108,345	90.5%
		484210	Used Household and Office Goods Moving	3,259	1,198,983	9.5%
		484220	Specialized Freight (except Used Goods) Trucking, Local	34,935	18,932,851	96.0%
		562111	Solid Waste Collection	7,083	18,211,495	100.0%
		562112	Hazardous Waste Collection	414	1,095,553	100.0%
		562119	Other Waste Collection	827	837,625	100.0%
4213	Trucking, Except Local	484121	General Freight Trucking, Long-Distance, Truckload	23,111	51,142,148	100.0%
		484122	General Freight Trucking, Long-Distance, Less Than Truckload	6,210	25,010,091	100.0%
		484210	Used Household and Office Goods Moving	3,555	9,111,477	72.4%
		484230	Specialized Freight (except Used Goods) Trucking, Long-Distance	14,439	20,500,392	100.0%
4214	Local Trucking with Storage	484110	General Freight Trucking, Local	915	1,164,931	9.5%
		484210	Used Household and Office Goods Moving	2,286	2,273,241	18.1%
		484220	Specialized Freight (except Used Goods) Trucking, Local	543	782,939	4.0%
4215	Courier Services, Except by Air	492110	Couriers	2,362	19,289,602	53.1%
		492210	Local Messengers and Local Delivery	5,384	3,519,100	100.0%
4231	Trucking Terminal Facilities	488490	Other Support Activities for Road Transportation	14	12,989	3.3%
<i>Electronic Equipment</i>						
3661	Telephone and Telegraph Apparatus	334210	Telephone Apparatus Manufacturing	598	38,300,044	100.0%
		334416	Electronic Coil, Transformer, and Other Inductor Manufacturing	7	8,904	0.6%
		334418	Printed Circuit Assembly (Electronic Assembly) Manufacturing	20	1,364,671	5.2%
3663	Radio and Television Broadcast and Comm Eq	334220	Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing	1,091	37,042,241	94.2%
3669	Communications Eq, N.E.C.	334290	Other Communications Equipment Manufacturing	497	4,233,288	100.0%
3671	Electron Tubes	334411	Electron Tube Manufacturing	159	3,858,499	100.0%
3675	Electronic Capacitors	334414	Electronic Capacitor Manufacturing	129	2,482,163	100.0%
3677	Electronic Coils and Transformers	334416	Electronic Coil, Transformer, and Other Inductor Manufacturing	426	1,512,232	97.9%
3678	Connectors for Electronic Applications	334417	Electronic Connector Manufacturing	347	5,598,906	100.0%

Table A.3: Relationships between SIC and NAICS Codes Based on 1997 Economic Census for MP&M Industries Evaluated for the Final Rule ^a (thousands, 1997\$)						
SIC	SIC Industry	NAICS Code	1997 NAICS Industry	Number of Establishments	Sales, Shipments or Receipts	Share Value
3679	Electronic Components N.E.C.	334220	Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing	126	2,265,873	5.8%
		334418	Printed Circuit Assembly (Electronic Assembly) Manufacturing	695	24,704,154	94.8%
		334419	Other Electronic Component Manufacturing	1,851	10,547,090	100.0%
		336322	Other Motor Vehicle Electrical and Electronic Equipment Manufacturing	253	1,420,996	8.4%
3699	Electronic Mach., Equipment, & Suppl. N.E.C.	332212	Hand and Edge Tool Manufacturing	4	140,811	2.1%
		333293	Printing Machinery and Equipment Manufacturing	5	0	0.9% ^b
		333314	Optical Instrument and Lens Manufacturing	5	7,320	0.2%
		333319	Other Commercial and Service Industry Machinery Manufacturing	57	934,728	10.0%
		333512	Machine Tool (Metal Cutting Types) Manufacturing	8	151,363	2.8%
		333618	Other Engine Equipment Manufacturing	2	0	0.7% ^b
		333992	Welding and Soldering Equipment Manufacturing	6	11,101	0.2%
		334510	Electromedical and Electrotherapeutic Apparatus Manufacturing	11	52,855	0.5%
		334511	Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing	7	77,832	0.2%
		334516	Analytical Laboratory Instrument Manufacturing	10	36,473	0.5%
		334519	Other Measuring and Controlling Device Manufacturing	5	6,174	0.1%
		335129	Other Lighting Equipment Manufacturing	4	859	0.0%
		335999	All Other Miscellaneous Electrical Equipment and Component Manufacturing	567	4,051,267	58.8%
Hardware						
2796	Platemaking and Related Services	323122	Prepress Services	1,276	2,663,020	53.2%
3398	Metal Heat Treating	332811	Metal Heat Treating	808	3,485,459	100.0%
3412	Metal Shipping Barrels, Drums, Kegs, Pails	332439	Other Metal Container Manufacturing	151	1,310,595	57.8%
3421	Cutlery	332211	Cutlery and Flatware (except Precious) Manufacturing	164	2,198,365	99.6%
3423	Hand & Edge Tools, Except Mach. Tools, Saws	332212	Hand and Edge Tool Manufacturing	1,069	5,677,903	86.0%
3425	Hand Saws and Saw Blades	332213	Saw Blade and Handsaw Manufacturing	176	1,452,540	100.0%

Table A.3: Relationships between SIC and NAICS Codes Based on 1997 Economic Census for MP&M Industries Evaluated for the Final Rule^a
(thousands, 1997\$)

SIC	SIC Industry	NAICS Code	1997 NAICS Industry	Number of Establishments	Sales, Shipments or Receipts	Share Value
3429	Hardware N.E.C.	332439	Other Metal Container Manufacturing	117	402,378	17.7%
		332510	Hardware Manufacturing	952	10,359,952	96.0%
		332919	Other Metal Valve and Pipe Fitting Manufacturing	16	0	3.9% ^b
3433	Heatg. Equip. Except Elec. & Warm Air Frnc.	333414	Heating Equipment (except Warm Air Furnaces) Manufacturing	453	3,387,391	91.1%
3441	Fabricated Structural Metal	332312	Fabricated Structural Metal Manufacturing	2,900	14,200,270	86.8%
3443	Fabricated Plate Work (Boiler Shops)	332313	Plate Work Manufacturing	1,035	2,806,913	100.0%
		332410	Power Boiler and Heat Exchanger Manufacturing	472	3,849,100	100.0%
		332420	Metal Tank (Heavy Gauge) Manufacturing	614	4,764,118	100.0%
		333415	Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing	9	43,264	0.2%
3444	Sheet Metal Work	332322	Sheet Metal Work Manufacturing	4,479	15,957,992	100.0%
		332439	Other Metal Container Manufacturing	126	275,440	12.1%
3446	Architectural and Ornamental Metal Work	332323	Ornamental and Architectural Metal Work Manufacturing	1,744	3,536,413	88.2%
3448	Prefabricated Metal Buildings & Components	332311	Prefabricated Metal Building and Component Manufacturing	604	4,199,550	100.0%
3449	Miscellaneous Metal Work	332114	Custom Roll Forming	401	3,074,662	100.0%
		332312	Fabricated Structural Metal Manufacturing	152	2,166,021	13.2%
		332321	Metal Window and Door Manufacturing	33	364,564	3.6%
		332323	Ornamental and Architectural Metal Work Manufacturing	6	91,939	2.3%
3451	Screw Machine Products	332721	Precision Turned Product Manufacturing	2,745	8,326,077	100.0%
3452	Bolts, Nuts, Screws, Rivets, and Washers	332722	Bolt, Nut, Screw, Rivet, and Washer Manufacturing	1,040	8,134,661	100.0%
3462	Iron and Steel Forgings	332111	Iron and Steel Forging	421	4,924,426	100.0%
3466	Crowns and Closures	332115	Crown and Closure Manufacturing	67	969,982	100.0%
3469	Metal Stamping N.E.C.	332116	Metal Stamping	2,166	12,041,638	100.0%
		332214	Kitchen Utensil, Pot, and Pan Manufacturing	77	1,369,914	100.0%
3492	Fluid Power Valves and Hose Fittings	332912	Fluid Power Valve and Hose Fitting Manufacturing	424	6,602,909	100.0%
3493	Steel Springs	332611	Spring (Heavy Gauge) Manufacturing	129	761,711	100.0%
3494	Valves & Pipe Fittings, Except Brass	332919	Other Metal Valve and Pipe Fitting Manufacturing	222	2,753,397	94.4%
		332999	All Other Miscellaneous Fabricated Metal Product Manufacturing	23	73,983	0.7%
3495	Wire Springs	332612	Spring (Light Gauge) Manufacturing	394	2,481,151	100.0%
		334518	Watch, Clock, and Part Manufacturing	2	0	2.5% ^b

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SIC	SIC Industry	NAICS Code	1997 NAICS Industry	Number of Establishments	Sales, Shipments or Receipts	Share Value
3496	Miscellaneous Fabricated Wire Products	332618	Other Fabricated Wire Product Manufacturing	1,253	4,587,656	87.3%
3498	Fabricated Pipe and Fabricated Pipe Fitting	332996	Fabricated Pipe and Pipe Fitting Manufacturing	856	4,024,999	100.0%
3499	Fabricated Metal Products N.E.C.	332117	Powder Metallurgy Part Manufacturing	128	1,317,301	100.0%
		332439	Other Metal Container Manufacturing	98	273,541	12.1%
		332510	Hardware Manufacturing	58	435,815	4.0%
		332919	Other Metal Valve and Pipe Fitting Manufacturing	7	0	1.7% ^b
		332999	All Other Miscellaneous Fabricated Metal Product Manufacturing	2,592	7,558,137	71.9%
		337215	Showcase, Partition, Shelving, and Locker Manufacturing	78	123,057	1.5%
		339914	Costume Jewelry and Novelty Manufacturing	82	49,953	3.9%
3541	Machine Tools, Metal Cutting Types	333512	Machine Tool (Metal Cutting Types) Manufacturing	393	5,183,521	97.2%
3542	Machine Tools, Metal Forming Types	333513	Machine Tool (Metal Forming Types) Manufacturing	225	2,255,011	100.0%
3544	Special Dies & Tools, Die Sets, Jigs, Etc.	333511	Industrial Mold Manufacturing	2,529	5,116,635	100.0%
		333514	Special Die and Tool, Die Set, Jig, and Fixture Manufacturing	4,746	8,244,855	100.0%
3545	Machine Tool Access & Measuring Devices	332212	Hand and Edge Tool Manufacturing	185	714,277	10.8%
		333515	Cutting Tool and Machine Tool Accessory Manufacturing	1,920	5,347,173	100.0%
3546	Power Driven Hand Tools	333991	Power-Driven Handtool Manufacturing	217	3,609,779	100.0%
3965	Fasteners, Buttons, Needles, Pins	339993	Fastener, Button, Needle, and Pin Manufacturing	249	0	99.2% ^b
<i>Household Equipment</i>						
2514	Metal Household Furniture	337124	Metal Household Furniture Manufacturing	420	2,422,853	100.0%
2522	Office Furniture, Except Wood	337214	Office Furniture (except Wood) Manufacturing	359	8,230,935	100.0%
2531	Public Bldng & Related Furniture	336360	Motor Vehicle Seating and Interior Trim Manufacturing	184	6,060,320	57.1%
		337127	Institutional Furniture Manufacturing	267	1,697,870	41.9%
		339942	Lead Pencil and Art Good Manufacturing	17	110,985	9.0%
2542	Partitions & Fixtures, Exc Wood	337215	Showcase, Partition, Shelving, and Locker Manufacturing	926	5,249,474	65.6%
2591	Drapery Hardware and Window Blinds/Shades	337920	Blind and Shade Manufacturing	488	2,393,564	100.0%
2599	Furniture and Fixtures, N.E.C.	337127	Institutional Furniture Manufacturing	727	2,305,770	57.0%
		339113	Surgical Appliance and Supplies Manufacturing	16	645,688	4.2%

Table A.3: Relationships between SIC and NAICS Codes Based on 1997 Economic Census for MP&M Industries Evaluated for the Final Rule^a
(thousands, 1997\$)

SIC	SIC Industry	NAICS Code	1997 NAICS Industry	Number of Establishments	Sales, Shipments or Receipts	Share Value
3431	Metal Sanitary Ware	332998	Enameled Iron and Metal Sanitary Ware Manufacturing	88	1,575,505	100.0%
3432	Plumbing Fittings and Brass Goods	332913	Plumbing Fixture Fitting and Trim Manufacturing	116	3,590,128	100.0%
		332999	All Other Miscellaneous Fabricated Metal Product Manufacturing	5	118,059	1.1%
3442	Metal Doors, Sash, and Trim	332321	Metal Window and Door Manufacturing	1,384	9,876,049	96.4%
3631	Household Cooking Equipment	335221	Household Cooking Appliance Manufacturing	84	3,543,231	100.0%
3632	Household Refrig. & Home & Farm & Freezers	335222	Household Refrigerator and Home Freezer Manufacturing	27	4,887,364	100.0%
3633	Household Laundry Equipment	335224	Household Laundry Equipment Manufacturing	17	3,723,375	100.0%
3634	Electric Housewares and Fans	333414	Heating Equipment (except Warm Air Furnaces) Manufacturing	16	329,270	8.9%
		335211	Electric Housewares and Household Fan Manufacturing	138	3,488,251	100.0%
3635	Household Vacuum Cleaners	335212	Household Vacuum Cleaner Manufacturing	34	2,399,206	100.0%
3639	Household Appliances N.E.C.	333298	All Other Industrial Machinery Manufacturing	4	0	0.2% ^b
		335228	Other Major Household Appliance Manufacturing	36	3,300,662	100.0%
3641	Electric Lamps	335110	Electric Lamp Bulb and Part Manufacturing	82	3,306,009	100.0%
3643	Current-Carrying Wiring Devices	335931	Current-Carrying Wiring Device Manufacturing	519	5,877,522	100.0%
3644	Noncurrent-Carrying Wiring Devices	335932	Noncurrent-Carrying Wiring Device Manufacturing	219	4,451,186	100.0%
3645	Residential Electrical Lighting Fixtures	335121	Residential Electric Lighting Fixture Manufacturing	497	2,177,355	96.6%
3646	Commercial, Industrial, and Institutional	335122	Commercial, Industrial, and Institutional Electric Lighting Fixture Manufacturing	356	4,047,437	100.0%
3648	Lighting Equipment N.E.C.	335129	Other Lighting Equipment Manufacturing	327	3,054,806	100.0%
3651	Radio/Television Sets Except Commun. Types	334310	Audio and Video Equipment Manufacturing	554	8,454,194	100.0%
7623	Refrig, air condition	811310	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	2,343	1,890,237	10.8%
		811412	Appliance Repair and Maintenance	1,671	789,622	19.9%
Instruments						
3812	Search, Det, Nav, Ggnc, Aero, Naut Sys/Inst	334511	Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing	680	32,497,776	99.8%
3821	Laboratory Apparatus and Furniture	339111	Laboratory Apparatus and Furniture Manufacturing	385	2,471,153	100.0%

SIC	SIC Industry	NAICS Code	1997 NAICS Industry	Number of Establishments	Sales, Shipments or Receipts	Share Value
3822	Automatic Environmental Controls	334512	Automatic Environmental Control Manufacturing for Residential, Commercial, and Appliance Use	317	2,935,692	100.0%
3823	Process Control Instruments	334513	Instruments and Related Products Manufacturing for Measuring, Displaying, and Controlling Industrial Process Variables	1,002	7,890,923	100.0%
3824	Fluid Meters and Counting Devices	334514	Totalizing Fluid Meter and Counting Device Manufacturing	222	3,765,769	100.0%
3825	Instruments to Measure Electricity	334416	Electronic Coil, Transformer, and Other Inductor Manufacturing	17	24,303	1.6%
		334515	Instrument Manufacturing for Measuring and Testing Electricity and Electrical Signals	826	13,852,897	100.0%
3826	Laboratory Analytical Instruments	334516	Analytical Laboratory Instrument Manufacturing	664	7,157,038	99.5%
3827	Optical Instruments and Lenses	333314	Optical Instrument and Lens Manufacturing	495	3,174,652	99.8%
3829	Measuring and Controlling Devices N.E.C.	334519	Other Measuring and Controlling Device Manufacturing	853	5,114,547	99.9%
		339112	Surgical and Medical Instrument Manufacturing	6	62,148	0.3%
3841	Surgical & Medical Instruments & Apparatus	339112	Surgical and Medical Instrument Manufacturing	1,598	18,450,024	99.7%
3842	Orthopedic, Prosthetic & Surgical Suppl.	322121	Paper (except Newsprint) Mills	2	0	1.4% ^b
		322291	Sanitary Paper Product Manufacturing	16	651,398	6.7%
		334510	Electromedical and Electrotherapeutic Apparatus Manufacturing	74	807,427	7.1%
		339113	Surgical Appliance and Supplies Manufacturing	1,636	14,743,779	95.8%
3843	Dental Equipment and Supplies	339114	Dental Equipment and Supplies Manufacturing	877	2,699,867	100.0%
3844	X-Ray Apparatus and Tubes	334517	Irradiation Apparatus Manufacturing	155	3,942,256	100.0%
3845	Electromedical Equipment	334510	Electromedical and Electrotherapeutic Apparatus Manufacturing	460	10,567,566	92.5%
3851	Ophthalmic Goods	339115	Ophthalmic Goods Manufacturing	575	3,607,813	100.0%
7629	Electric repair shop	811212	Computer and Office Machine Repair and Maintenance	1,538	913,258	10.7%
		811213	Communication Equipment Repair and Maintenance	201	231,458	14.4%
		811219	Other Electronic and Precision Equipment Repair and Maintenance	2,033	2,509,452	86.1%
		811411	Home and Garden Equipment Repair and Maintenance	579	185,507	18.5%
		811412	Appliance Repair and Maintenance	4,327	3,125,853	78.6%

Table A.3: Relationships between SIC and NAICS Codes Based on 1997 Economic Census for MP&M Industries Evaluated for the Final Rule^a
(thousands, 1997\$)

SIC	SIC Industry	NAICS Code	1997 NAICS Industry	Number of Establishments	Sales, Shipments or Receipts	Share Value
Iron and Steel						
3315	Steel Wiredrawing and Steel Nails and Spikes	331222	Steel Wire Drawing	273	4,920,798	100.0%
		332618	Other Fabricated Wire Product Manufacturing	31	370,492	7.0%
3316	Cold-Rolled Steel Sheet, Strip, and Bars	331221	Rolled Steel Shape Manufacturing	186	6,343,466	100.0%
3317	Steel Pipe and Tubes	331210	Iron and Steel Pipe and Tube Manufacturing from Purchased Steel	235	7,565,377	100.0%
Job Shop						
3471	Plating and Polishing	332813	Electroplating, Plating, Polishing, Anodizing, and Coloring	3,404	5,979,405	100.0%
3479	Metal Coating & Allied Services	332812	Metal Coating, Engraving (except Jewelry and Silverware), and Allied Services to Manufacturers	2,156	8,460,896	100.0%
		339911	Jewelry (except Costume) Manufacturing	22	5,798	0.1%
		339914	Costume Jewelry and Novelty Manufacturing	16	2,257	0.2%
		339912	Silverware and Hollowware Manufacturing	12	6,296	0.7%
Mobile Industrial Equipment						
3523	Farm Machinery and Equipment	332212	Hand and Edge Tool Manufacturing	1	0	0.1% ^b
		332323	Ornamental and Architectural Metal Work Manufacturing	140	380,152	9.5%
		333111	Farm Machinery and Equipment Manufacturing	1,339	15,921,455	100.0%
		333922	Conveyor and Conveying Equipment Manufacturing	28	33,377	0.5%
3524	Garden Tractors & Lawn & Garden Equipment	332212	Hand and Edge Tool Manufacturing	3	0	0.3% ^b
		333112	Lawn and Garden Tractor and Home Lawn and Garden Equipment Manufacturing	145	7,454,511	100.0%
3531	Constr Mach and Eq	333120	Construction Machinery Manufacturing	785	21,965,455	100.0%
		333923	Overhead Traveling Crane, Hoist, and Monorail System Manufacturing	87	1,805,198	57.4%
		336510	Railroad Rolling Stock Manufacturing	25	346,760	4.2%
3532	Mining Mach. & Equip., Except Oil Field	333131	Mining Machinery and Equipment Manufacturing	292	2,710,923	100.0%
3536	Hoists, Industrial Cranes & Monorails	333923	Overhead Traveling Crane, Hoist, and Monorail System Manufacturing	220	1,340,561	42.6%
3537	Industrial Trucks, Tractors, Trailers	332439	Other Metal Container Manufacturing	4	6,775	0.3%
		332999	All Other Miscellaneous Fabricated Metal Product Manufacturing	19	27,488	0.3%
		333924	Industrial Truck, Tractor, Trailer, and Stacker Machinery Manufacturing	461	5,538,326	100.0%
3795	Tanks and Tank Components	336992	Military Armored Vehicle, Tank, and Tank Component Manufacturing	37	0	86.0% ^b

Table A.3: Relationships between SIC and NAICS Codes Based on 1997 Economic Census for MP&M Industries Evaluated for the Final Rule ^a (thousands, 1997\$)						
SIC	SIC Industry	NAICS Code	1997 NAICS Industry	Number of Establishments	Sales, Shipments or Receipts	Share Value
<i>Motor Vehicle</i>						
3465	Automotive Stampings	336370	Motor Vehicle Metal Stamping	810	23,668,110	100.0%
3592	Carburetors, Piston Rings, Valves	336311	Carburetor, Piston, Piston Ring, and Valve Manufacturing	141	2,755,311	100.0%
3647	Vehicular Lighting Equipment	336321	Vehicular Lighting Equipment Manufacturing	106	3,282,824	100.0%
3694	Electrical Equipment for Motor Vehicles	336322	Other Motor Vehicle Electrical and Electronic Equipment Manufacturing	569	9,074,335	53.6%
3711	Motor Vehicle and Automobile Bodies	336111	Automobile Manufacturing	194	95,385,563	100.0%
		336112	Light Truck and Utility Vehicle Manufacturing	112	110,400,169	100.0%
		336120	Heavy Duty Truck Manufacturing	84	14,490,344	100.0%
		336211	Motor Vehicle Body Manufacturing	76	82,633	0.9%
		336992	Military Armored Vehicle, Tank, and Tank Component Manufacturing	6	0	14.0% ^b
3714	Motor Vehicle Parts and Accessories	336211	Motor Vehicle Body Manufacturing	23	265,552	2.9%
		336312	Gasoline Engine and Engine Parts Manufacturing	881	25,974,369	100.0%
		336322	Other Motor Vehicle Electrical and Electronic Equipment Manufacturing	193	6,446,681	38.1%
		336330	Motor Vehicle Steering and Suspension Components (except Spring) Manufacturing	212	10,750,312	100.0%
		336340	Motor Vehicle Brake System Manufacturing	269	10,033,288	100.0%
		336350	Motor Vehicle Transmission and Power Train Parts Manufacturing	523	33,288,093	100.0%
		336399	All Other Motor Vehicle Parts Manufacturing	1,508	34,193,298	99.6%
3716	Mobile Homes	336213	Motor Home Manufacturing	88	3,943,709	100.0%
3751	Motorcycles	336991	Motorcycle, Bicycle, and Parts Manufacturing	385	0	99.0% ^b
3792	Travel Trailers and Campers	336214	Travel Trailer and Camper Manufacturing	315	3,076,049	67.4%
3799	Miscellaneous Transportation Equipment	332212	Hand and Edge Tool Manufacturing	1	0	0.1% ^b
		336214	Travel Trailer and Camper Manufacturing	498	1,485,367	32.6%
		336999	All Other Transportation Equipment Manufacturing	378	4,557,989	100.0%
4121	Taxicabs	485310	Taxi Service	3,184	1,280,597	100.0%
5013	Motor Vehicle Supplies and New Parts	421120	Motor Vehicle Supplies and New Parts Wholesalers	12,620	83,214,728	100.0%
		441310	Automotive Parts and Accessories Stores	16,253	22,093,428	51.2%
5511	Motor Vehicle Dealers (New and Used)	441110	New Car Dealers	25,897	518,971,824	100.0%
5521	Motor Vehicle Dealers (Used Only)	441120	Used Car Dealers	23,340	34,680,468	100.0%
5561	Recreational Vehicle Dealers	441210	Recreational Vehicle Dealers	3,014	10,069,749	100.0%

Table A.3: Relationships between SIC and NAICS Codes Based on 1997 Economic Census for MP&M Industries Evaluated for the Final Rule^a
(thousands, 1997\$)

SIC	SIC Industry	NAICS Code	1997 NAICS Industry	Number of Establishments	Sales, Shipments or Receipts	Share Value
5571	Motorcycle Dealers	441221	Motorcycle Dealers	3,635	7,369,260	100.0%
5599	Automotive Dealers, N.E.C.	441229	All Other Motor Vehicle Dealers	1,678	2,517,267	100.0%
7514	Passenger Car Rental	532111	Passenger Car Rental	4,367	14,783,704	100.0%
7515	Passenger Car Lease	532112	Passenger Car Leasing	879	3,800,424	100.0%
7519	Utility Trailer and Recreational Vehicle Rental	532120	Truck, Utility Trailer, and RV (Recreational Vehicle) Rental and Leasing	360	256,119	2.5%
7532	Top, Body, and Upholstery Repair and Paint Shops	811121	Automotive Body, Paint, and Interior Repair and Maintenance	35,569	17,755,296	100.0%
7533	Auto Exhaust Systems	811112	Automotive Exhaust System Repair	5,251	1,985,377	100.0%
7537	Auto Transmission Repair	811113	Automotive Transmission Repair	6,768	2,431,584	100.0%
7538	Gen Automotive Repair	811111	General Automotive Repair	77,751	25,598,455	100.0%
7539	Auto Repair Shop, N.E.C.	811118	Other Automotive Mechanical and Electrical Repair and Maintenance	9,674	3,494,643	100.0%
7549	Auto Services, Except Repair and Carwashes	488410	Motor Vehicle Towing	5,893	2,295,188	100.0%
		811191	Automotive Oil Change and Lubrication Shops	7,413	2,787,318	100.0%
		811198	All Other Automotive Repair and Maintenance	1,646	798,626	73.5%
Office Machine						
3571	Electronic Computers	334111	Electronic Computer Manufacturing	563	66,331,909	100.0%
3572	Typewriters	334112	Computer Storage Device Manufacturing	211	13,907,367	100.0%
3575	Computer Terminals	334113	Computer Terminal Manufacturing	142	1,483,460	100.0%
3577	Computer Peripheral Eq N.E.C.	334119	Other Computer Peripheral Equipment Manufacturing	1,006	25,130,308	93.1%
3578	Calculating, Accounting Machines Except Computers	333313	Office Machinery Manufacturing	35	144,380	4.5%
		334119	Other Computer Peripheral Equipment Manufacturing	61	1,870,426	6.9%
3579	Office Machines, N.E.C.	333313	Office Machinery Manufacturing	134	3,047,549	95.5%
		334518	Watch, Clock, and Part Manufacturing	16	0	19.6% ^b
		339942	Lead Pencil and Art Good Manufacturing	13	257,020	20.8%
7378	Computer Maintenance and Repairs	811212	Computer and Office Machine Repair and Maintenance	6,087	7,565,169	89.0%
7379	Computer Related Services, N.E.C.	334611	Software Reproducing	124	1,258,435	100.0%
		541512	Computer Systems Design Services	20,233	15,942,861	31.1%
		541519	Other Computer Related Services	8,405	4,339,989	100.0%
Ordnance						
3482	Small Arms Ammunition	332992	Small Arms Ammunition Manufacturing	113	938,818	100.0%
3483	Ammunition, Except for Small Arms	332993	Ammunition (except Small Arms) Manufacturing	53	1,497,045	100.0%
3484	Small Arms	332994	Small Arms Manufacturing	198	1,251,792	100.0%

Table A.3: Relationships between SIC and NAICS Codes Based on 1997 Economic Census for MP&M Industries Evaluated for the Final Rule ^a (thousands, 1997\$)						
SIC	SIC Industry	NAICS Code	1997 NAICS Industry	Number of Establishments	Sales, Shipments or Receipts	Share Value
3489	Ordnance and Accessories, N.E.C.	332995	Other Ordnance and Accessories Manufacturing	70	1,750,485	100.0%
<i>Miscellaneous Metal Products</i>						
3497	Metal Foil and Leaf	322225	Laminated Aluminum Foil Manufacturing for Flexible Packaging Uses	43	1,546,143	100.0%
		332999	All Other Miscellaneous Fabricated Metal Product Manufacturing	64	1,711,600	16.3%
3861	Photographic Equipment & Supplies	325992	Photographic Film, Paper, Plate, and Chemical Manufacturing	311	12,895,637	100.0%
		333315	Photographic and Photocopying Equipment Manufacturing	428	8,410,124	100.0%
3931	Musical Instruments	339992	Musical Instrument Manufacturing	576	1,356,651	100.0%
3944	Games, Toys, Children's Vehicles	336991	Motorcycle, Bicycle, and Parts Manufacturing	4	0	1.0% ^b
		339932	Game, Toy, and Children's Vehicle Manufacturing	785	4,534,497	100.0%
3949	Sporting and Athletic Goods, N.E.C.	339920	Sporting and Athletic Goods Manufacturing	2,571	10,591,160	100.0%
3951	Pens and Mechanical Pencils	339941	Pen and Mechanical Pencil Manufacturing	112	1,590,770	100.0%
3953	Marking Devices	339943	Marking Device Manufacturing	634	643,007	100.0%
3993	Signs and Advertising Displays	339950	Sign Manufacturing	5,709	7,910,809	100.0%
3995	Burial Caskets	339995	Burial Casket Manufacturing	177	1,271,184	100.0%
3999	Manufacturing Industries, N.E.C.	314999	All Other Miscellaneous Textile Product Mills	52	173,353	2.8%
		316110	Leather and Hide Tanning and Finishing	26	24,625	0.7%
		325998	All Other Miscellaneous Chemical Product and Preparation Manufacturing	9	80,624	0.6%
		326199	All Other Plastics Product Manufacturing	140	319,241	0.5%
		332212	Hand and Edge Tool Manufacturing	7	0	0.6% ^b
		332999	All Other Miscellaneous Fabricated Metal Product Manufacturing	185	285,362	2.7%
		335121	Residential Electric Lighting Fixture Manufacturing	53	69,864	3.1%
		337127	Institutional Furniture Manufacturing	5	28,296	0.7%
		339999	All Other Miscellaneous Manufacturing	2,284	7,183,815	85.4%
7692	Welding Repair	811490	Other Personal and Household Goods Repair and Maintenance	4,840	1,640,808	36.8%

Table A.3: Relationships between SIC and NAICS Codes Based on 1997 Economic Census for MP&M Industries Evaluated for the Final Rule^a
(thousands, 1997\$)

SIC	SIC Industry	NAICS Code	1997 NAICS Industry	Number of Establishments	Sales, Shipments or Receipts	Share Value
7699	Repair Shop, Related Service	488390	Other Support Activities for Water Transportation	12	4,737	0.7%
		561622	Locksmiths	3,799	1,081,317	100.0%
		561790	Other Services to Buildings and Dwellings	1,254	0	22.4% ^b
		562991	Septic Tank and Related Services	2,538	0	81.8% ^b
		811212	Computer and Office Machine Repair and Maintenance	104	23,844	0.3%
		811219	Other Electronic and Precision Equipment Repair and Maintenance	838	404,627	13.9%
		811310	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	16,404	13,600,413	77.7%
		811411	Home and Garden Equipment Repair and Maintenance	3,032	816,008	81.5%
		811412	Appliance Repair and Maintenance	181	59,338	1.5%
		811430	Footwear and Leather Goods Repair	82	18,294	7.0%
		811490	Other Personal and Household Goods Repair and Maintenance	3,946	1,362,271	30.6%
3873	Watches, Clocks, and Watchcases	334518	Watch, Clock, and Part Manufacturing	128	718,191	77.9%
<i>Precious Metals and Jewelry</i>						
3911	Jewelry, Precious Metal	339911	Jewelry (except Costume) Manufacturing	2,272	5,416,836	99.9%
3914	Silverware, Plated Ware & Stainless	332211	Cutlery and Flatware (except Precious) Manufacturing	11	8,032	0.4%
		339912	Silverware and Hollowware Manufacturing	151	899,684	99.3%
3915	Jewelers' Materials & Lapidary Work	339913	Jewelers' Material and Lapidary Work Manufacturing	394	919,066	100.0%
3961	Costume Jewelry	339914	Costume Jewelry and Novelty Manufacturing	826	1,223,475	95.9%
7631	Watch, Clock, Jewelry Repair	811490	Other Personal and Household Goods Repair and Maintenance	1,716	345,774	7.8%
<i>Printed Circuit Boards</i>						
3672	Printed Circuit Boards	334412	Bare Printed Circuit Board Manufacturing	1,401	9,787,576	100.0%
<i>Railroad</i>						
3743	Railcars, Railway Systems	336510	Railroad Rolling Stock Manufacturing	207	7,916,635	95.8%
<i>Ships and Boats</i>						
3731	Ship Building and Repairing	336611	Ship Building and Repairing	700	10,571,810	100.0%
3732	Boat Building and Repairing	336612	Boat Building	1,043	5,622,040	100.0%
		811490	Other Personal and Household Goods Repair and Maintenance	1,739	821,273	18.4%
4412	Deep Sea Foreign Transportation	483111	Deep Sea Freight Transportation	487	11,570,718	100.0%
4424	Deep Sea Domestic Transportation	483113	Coastal and Great Lakes Freight Transportation	292	3,114,639	66.6%

Table A.3: Relationships between SIC and NAICS Codes Based on 1997 Economic Census for MP&M Industries Evaluated for the Final Rule^a
(thousands, 1997\$)

SIC	SIC Industry	NAICS Code	1997 NAICS Industry	Number of Establishments	Sales, Shipments or Receipts	Share Value
4432	Freight Transportation Great Lakes	483113	Coastal and Great Lakes Freight Transportation	32	519,863	11.1%
4449	Water Transportation of Freight, N.E.C.	483211	Inland Water Freight Transportation	222	2,821,121	83.3%
4481	Deep Sea Passenger Transportation	483112	Deep Sea Passenger Transportation	80	3,908,143	100.0%
		483114	Coastal and Great Lakes Passenger Transportation	64	89,597	49.2%
4482	Ferries	483114	Coastal and Great Lakes Passenger Transportation	61	92,493	50.8%
		483212	Inland Water Passenger Transportation	76	121,992	41.6%
4489	Water Passenger Transportation, N.E.C.	483212	Inland Water Passenger Transportation	154	171,135	58.4%
		487210	Scenic and Sightseeing Transportation, Water	654	861,001	76.3%
4491	Marine Cargo Handling	488310	Port and Harbor Operations	168	889,125	100.0%
		488320	Marine Cargo Handling	623	4,456,243	100.0%
4492	Towing & Tugboat Service	483113	Coastal and Great Lakes Freight Transportation	292	1,043,440	22.3%
		483211	Inland Water Freight Transportation	161	566,027	16.7%
		488330	Navigational Services to Shipping	361	1,014,026	67.0%
4493	Marinas	713930	Marinas	4,217	2,541,481	100.0%
4499	Water Transportation Services, N.E.C.	488330	Navigational Services to Shipping	504	499,176	33.0%
		488390	Other Support Activities for Water Transportation	640	444,499	67.7%
		532411	Commercial Air, Rail, and Water Transportation Equipment Rental and Leasing	126	454,392	7.1%
Stationary Industrial Equipment						
3511	Steam, Gas, Hydraulic Turbines, Generator Units	333611	Turbine and Turbine Generator Set Units Manufacturing	86	5,783,057	100.0%
3519	Internal Combustion Engines, N.E.C.	333618	Other Engine Equipment Manufacturing	297	0	99.3% ^b
		336399	All Other Motor Vehicle Parts Manufacturing	7	123,954	0.4%
3533	Oil Field Machinery and Equipment	333132	Oil and Gas Field Machinery and Equipment Manufacturing	563	6,240,079	100.0%
3534	Elevators and Moving Stairways	333921	Elevator and Moving Stairway Manufacturing	196	1,607,066	100.0%
3535	Conveyors and Conveying Equipment	333922	Conveyor and Conveying Equipment Manufacturing	871	6,346,525	99.5%
3543	Industrial Patterns	332997	Industrial Pattern Manufacturing	673	623,927	100.0%
3547	Rolling Mill Machinery and Equipment	333516	Rolling Mill Machinery and Equipment Manufacturing	100	700,084	100.0%
3548	Electric and Gas Welding and Soldering	333992	Welding and Soldering Equipment Manufacturing	244	4,433,877	99.8%
3549	Metal Working Machinery, N.E.C.	333518	Other Metalworking Machinery Manufacturing	474	3,463,811	100.0%

Table A.3: Relationships between SIC and NAICS Codes Based on 1997 Economic Census for MP&M Industries Evaluated for the Final Rule^a (thousands, 1997\$)

SIC	SIC Industry	NAICS Code	1997 NAICS Industry	Number of Establishments	Sales, Shipments or Receipts	Share Value
3552	Textile Machinery	333292	Textile Machinery Manufacturing	478	1,779,034	100.0%
3553	Woodworking Machinery	333210	Sawmill and Woodworking Machinery Manufacturing	327	1,321,752	100.0%
3554	Paper Industries Machinery	333291	Paper Industry Machinery Manufacturing	366	3,438,235	100.0%
3555	Printing Trades Machinery and Equipment	333293	Printing Machinery and Equipment Manufacturing	546	0	99.1% ^b
3556	Food Products Mach	333294	Food Product Machinery Manufacturing	597	2,877,841	100.0%
3559	Special Industry Machinery, N.E.C.	333220	Plastics and Rubber Industry Machinery Manufacturing	455	3,584,992	100.0%
		333295	Semiconductor Machinery Manufacturing	257	11,158,627	100.0%
		333298	All Other Industrial Machinery Manufacturing	1,677	0	99.8% ^b
		333319	Other Commercial and Service Industry Machinery Manufacturing	78	644,019	6.9%
3561	Pumps and Pumping Equipment	333911	Pump and Pumping Equipment Manufacturing	489	6,826,043	100.0%
3562	Ball and Roller Bearings	332991	Ball and Roller Bearing Manufacturing	185	6,120,940	100.0%
3563	Air and Gas Compressors	333912	Air and Gas Compressor Manufacturing	314	5,633,008	100.0%
3564	Blowers and Exhaust and Ventilation Fans	333411	Air Purification Equipment Manufacturing	370	2,174,729	100.0%
		333412	Industrial and Commercial Fan and Blower Manufacturing	204	1,901,196	100.0%
3565	Industrial Patterns	333993	Packaging Machinery Manufacturing	689	4,858,270	100.0%
3566	Speed Changers, High Speed Drivers & Gears	333612	Speed Changer, Industrial High-Speed Drive, and Gear Manufacturing	268	2,402,392	100.0%
3567	Industrial Process Furnaces and Ovens	333994	Industrial Process Furnace and Oven Manufacturing	404	2,871,475	100.0%
3568	Mechanical Power Transmission Equipment, N.E.C.	333613	Mechanical Power Transmission Equipment Manufacturing	299	3,301,091	100.0%
3569	General Industrial Machinery, N.E.C.	333999	All Other Miscellaneous General Purpose Machinery Manufacturing	1,257	7,991,746	87.5%
3581	Automatic Merchandising Machines	333311	Automatic Vending Machine Manufacturing	121	1,325,960	100.0%
3582	Commercial Laundry Equipment	333312	Commercial Laundry, Drycleaning, and Pressing Machine Manufacturing	68	604,966	100.0%
3585	Refrigeration & Air and Heating Equipment	333415	Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing	792	22,846,865	99.8%
		336391	Motor Vehicle Air-Conditioning Manufacturing	60	5,626,596	100.0%
3586	Measuring and Dispensing Pumps	333913	Measuring and Dispensing Pump Manufacturing	71	1,316,899	100.0%
3589	Service Industry Machines, N.E.C.	333319	Other Commercial and Service Industry Machinery Manufacturing	1,165	7,596,253	81.3%

Table A.3: Relationships between SIC and NAICS Codes Based on 1997 Economic Census for MP&M Industries Evaluated for the Final Rule ^a (thousands, 1997\$)						
SIC	SIC Industry	NAICS Code	1997 NAICS Industry	Number of Establishments	Sales, Shipments or Receipts	Share Value
3593	Fluid Power Cylinders and Actuators	333995	Fluid Power Cylinder and Actuator Manufacturing	320	3,528,906	100.0%
3594	Fluid Power Pumps and Motors	333996	Fluid Power Pump and Motor Manufacturing	170	2,712,058	100.0%
3596	Scales and Balances, except Laboratory	333997	Scale and Balance (except Laboratory) Manufacturing	122	682,940	100.0%
3599	Machinery, Except Electrical, N.E.C.	332710	Machine Shops	23,619	27,143,131	100.0%
		332999	All Other Miscellaneous Fabricated Metal Product Manufacturing	132	506,611	4.8%
		333319	Other Commercial and Service Industry Machinery Manufacturing	50	172,536	1.8%
		333999	All Other Miscellaneous General Purpose Machinery Manufacturing	836	1,146,348	12.5%
3612	Transformers	335311	Power, Distribution, and Specialty Transformer Manufacturing	318	4,716,162	100.0%
3613	Switchgear and Switchboard Apparatus	335313	Switchgear and Switchboard Apparatus Manufacturing	583	7,609,164	100.0%
3621	Motors and Generators	335312	Motor and Generator Manufacturing	528	11,788,281	96.3%
3629	Electric Industrial Apparatus, N.E.C.	335999	All Other Miscellaneous Electrical Equipment and Component Manufacturing	413	2,838,366	41.2%
7353	Heavy Construction Equip Rental, Leasing	234990	All Other Heavy Construction	2,295	2,734,732	8.7%
		532412	Construction, Mining, and Forestry Machinery and Equipment Rental and Leasing	3,286	5,339,163	77.4%
7359	Equip Rental, Leasing, N.E.C.	532210	Consumer Electronics and Appliances Rental	3,011	1,790,890	100.0%
		532299	All Other Consumer Goods Rental	3,133	2,133,450	99.1%
		532310	General Rental Centers	6,509	3,910,618	100.0%
		532411	Commercial Air, Rail, and Water Transportation Equipment Rental and Leasing	498	0	74.3% ^b
		532412	Construction, Mining, and Forestry Machinery and Equipment Rental and Leasing	671	1,555,089	22.6%
		532420	Office Machinery and Equipment Rental and Leasing	400	436,178	7.1%
		532490	Other Commercial and Industrial Machinery and Equipment Rental and Leasing	3,408	6,775,140	69.7%
		562991	Septic Tank and Related Services	563	0	18.2% ^b

^a EPA evaluated options for these industrial sectors but did not regulate them all under the final rule.

^b Share values were calculated using estimated value of shipments data.

N.E.C. = Not Elsewhere Classified

Source: Department of Commerce, Bureau of the Census, 1997 Economic Census, Bridge Between NAICS and SIC; and EPA analysis.

A.2 ANNUAL ESTABLISHMENT “BIRTHS” AND “DEATHS” IN MP&M INDUSTRIES EVALUATED FOR THE FINAL RULE

EPA used the Statistics of U.S. Businesses (SUSB) dynamic data to estimate the rate at which MP&M facilities evaluated for the final rule enter and leave the industry each year. The SUSB dynamic data report numbers of facilities starting up, closing, expanding employment and contracting employment each year from 1989 through 1997 (the latest currently available.)

Table A.4 shows the average number of facilities (establishments) operating at the beginning of each year for the period 1989 through 1997, the number of facility “births” and “deaths”, and the average “birth rate” and “death rate” for each of the major 3-digit manufacturing SIC codes that include MP&M 4-digit SIC codes evaluated for the final rule.² This table shows that, over the period 1989-1997, annual closure rates ranged from 6 to over 12 percent in the different industries, with an overall average of almost 8 percent.

SIC	SIC Description	Average # Establishments at the Beginning of the Year	Average Establishment Births	Average Establishment Deaths	% Births	% Deaths
3410	Metal Cans And Shipping Containers	464	22	35	4.7%	7.5%
3420	Cutlery, Handtools, And Hardware	2,294	143	139	6.2%	6.1%
3430	Plumbing And Heating, Except Electric	687	45	53	6.6%	7.8%
3440	Fabricated Structural Metal Products	12,268	853	908	7.0%	7.4%
3450	Screw Machine Products, Bolts, Etc.	2,436	84	111	3.4%	4.6%
3460	Metal Forgings And Stamping	3,812	199	226	5.2%	5.9%
3470	Metal Services, N.E.C.	5,028	341	340	6.8%	6.8%
3480	Ordinance & Accessories, N.E.C.	390	39	40	10.0%	10.2%
3490	Misc. Fabricated Metal Products	7,084	606	531	8.6%	7.5%
3510	Engines And Turbines	346	26	24	7.5%	6.8%
3520	Farm And Garden Machinery	1,711	133	129	7.8%	7.5%
3530	Construction And Related Machinery	3,165	217	230	6.9%	7.3%
3540	Metalworking Machinery	11,072	672	660	6.1%	6.0%
3550	Special Industry Machinery	4,427	307	317	6.9%	7.1%
3560	General Industrial Machinery	3,961	243	225	6.1%	5.7%
3570	Computer And Office Equipment	2,025	262	246	12.9%	12.1%
3580	Refrigeration And Service Machinery	2,104	154	165	7.3%	7.9%
3590	Industrial Machinery, N.E.C.	21,972	1,996	1,659	9.1%	7.5%
3610	Electric Distribution Equipment	764	53	51	6.9%	6.6%
3620	Electrical Industrial Apparatus	2,024	117	130	5.8%	6.4%
3630	Household Appliances	461	44	41	9.5%	8.9%

² The data are disaggregated only to the 3-digit SIC level, and EPA therefore was unable to calculate closure rates for the specific 4-digit SICs that comprise the MP&M industries evaluated for the final rule. The analysis does not include 3-digit SICs that may include large numbers of non-metal products producers, for example SIC 241 (furniture, both wood and metal.)

Table A.4: Annual Births and Deaths for MP&M Establishments Evaluated for the Final Rule by 3 Digit SIC Codes (1989-1997)

SIC	SIC Description	Average # Establishments at the Beginning of the Year	Average Establishment Births	Average Establishment Deaths	% Births	% Deaths
3640	Electric Lighting And Wiring Equipment	1,905	123	143	6.5%	7.5%
3650	Household Audio & Video Equip	766	96	87	12.5%	11.4%
3660	Communications Equipment	1,794	169	159	9.4%	8.9%
3670	Electronic Components And Accessories	6,068	614	522	10.1%	8.6%
3690	Misc. Electrical Equipment & Supplies	1,890	136	157	7.2%	8.3%
3710	Motor Vehicles And Equipment	4,477	387	372	8.6%	8.3%
3720	Aircraft And Parts	1,633	122	127	7.5%	7.8%
3730	Ship And Boat Building And Repairing	2,669	343	339	12.9%	12.7%
3740	Railroad Equipment	189	15	15	7.9%	7.7%
3750	Motorcycles, Bicycles, & Parts	256	38	25	14.8%	9.7%
3760	Guided Missiles, Space Vehicles, Parts	127	7	11	5.5%	8.4%
3790	Miscellaneous Transportation Equipment	962	106	109	11.0%	11.3%
3810	Search & Navigation Equipment	758	34	60	4.5%	7.9%
3820	Measuring And Controlling Devices	4,209	275	295	6.5%	7.0%
3840	Medical Instruments And Supplies	3,770	334	289	8.9%	7.7%
3850	Ophthalmic Goods	536	40	48	7.5%	8.9%
3860	Photographic Equip & Supplies	784	71	72	9.1%	9.1%
3870	Watches, Clocks, Watchcases & Parts	159	12	20	7.5%	12.7%
3910	Jewelry, Silverware, And Plated Ware	2,606	246	275	9.4%	10.6%
3930	Musical Instruments	434	46	35	10.6%	8.0%
3940	Toys And Sporting Goods	2,843	384	345	13.5%	12.1%
3950	Pens, Pencils, Office, & Art Supplies	975	62	70	6.4%	7.2%
3960	Costume Jewelry And Notions	1,010	105	128	10.4%	12.7%
3990	Miscellaneous Manufactures	7,338	784	740	10.7%	10.1%
TOTAL		136,653	11,103	10,698	8.1%	7.8%

N.E.C. = Not Elsewhere Classified

Source: Small Business Administration, Statistics of U.S. Businesses.

A.3 DESCRIPTION OF MP&M SURVEYS

EPA used two screener and seven detailed questionnaires (surveys) issued between 1989 and 1996 to collect financial and technical data from a sample of facilities that were evaluated for regulation under the final MP&M rule (see Section 3 of the TDD). The responses to these surveys provided the basic financial and economic information used in the facility and firm impact analyses. In addition, the POTW Survey provided information on facility permitting costs associated with regulatory options considered by EPA. The various surveys are described below as they relate to the financial and economic analyses. The MP&M rulemaking docket provides copies of the survey instruments and detailed information on the conduct of the surveys.

A.3.1 Screener Surveys

In 1990, EPA distributed 8,342 screener surveys to sites believed to be engaged in the original seven Phase I MP&M sectors. In 1996, EPA distributed 5,325 screener surveys to sites believed to be engaged in the eleven Phase II MP&M sectors. The screener surveys helped EPA to identify sites to receive the more detailed follow-up surveys and to make a preliminary assessment of the MP&M industry evaluated for the final rule. EPA identified the SIC codes applicable to the respective MP&M sectors evaluated for the final rule and randomly selected names and addresses in those SICs to receive the screener surveys based on Dun & Bradstreet databases.

A.3.2 Ohio Screener Surveys

EPA also sent the 1996 screener survey to 1,600 randomly selected sites in Ohio to support the Ohio case study.

A.3.3 Detailed MP&M Industry Surveys

Based on responses to the screener surveys, EPA sent a more detailed survey to a selected group of water-using MP&M facilities evaluated for the final rule. EPA collected financial and technical data from sample facilities in two phases.

Based on responses to the 1990 screener, EPA sent the Phase I detailed survey to a select group of water-using facilities. The Agency designed this survey to collect detailed technical and financial information. EPA selected 1,020 detailed survey recipients from water-discharging screener respondents, water-using screener respondents that did not discharge process water, and a non-randomly selected group of known water-discharging facilities that did not receive the screener.

EPA used information from the first two groups of survey recipients to develop pollutant loadings and reductions and to develop compliance cost estimates. Because EPA did not randomly select the third group of recipients, EPA did not use the data to develop national estimates.

To reduce burden on survey recipients for Phase II of the data collection effort, EPA developed two similar detailed surveys. Based on the development of the 1995 MP&M proposal, EPA chose to collect more detailed information from sites with annual process wastewater discharges greater than one million gallons per year (1 MGY). EPA sent the “long” detailed survey to all 353 1996 screener respondents evaluated for the final rule who indicated they discharged one million or more gallons of process wastewater annually and performed MP&M operations. The Agency sent the “short” detailed survey to 101 randomly selected 1996 screener respondents evaluated for the final rule who indicated they discharged less than one million gallons of process wastewater annually and performed MP&M operations.

The detailed survey responses provide financial, economic, and employment information about the site or the company owning the facility. In addition, the 1996 long detailed questionnaire included a section that requested supplemental information on other facilities owned by the company. EPA included this voluntary section to measure the impact of the final MP&M effluent guidelines on companies with multiple facilities that discharge process wastewater. This section requested the same information collected in the 1996 MP&M screener survey. Responses to questions in this section provided information on the size, industrial sector, revenue, unit operations, and water usage of the company’s other facilities.

The 1996 short survey included the identical general facility and economic information collected in the long detailed survey, with one exception. Short survey recipients were not asked to provide information on the liquidation value of their plant.

A.3.4 Iron and Steel Survey

EPA also developed a detailed survey, under a separate rulemaking effort, to collect detailed information from facilities covered by the Iron and Steel Manufacturing effluent guidelines (40 CFR Part 420). Following field sampling of iron and steel sites and review of the completed industry surveys, EPA decided at proposal that some iron and steel operations would be more appropriately covered by the MP&M rule because they were more like MP&M operations. EPA relied on the Iron & Steel survey for financial and economic information on 47 iron and steel facilities. Commenters on the proposed rule stated that these operations and resulting wastewaters are comparable to those at facilities subject to the Iron and Steel Manufacturing effluent guidelines and that these discharges should remain subject to Part 420 rather than the final MP&M rule. Also at NODA, EPA considered including in the Steel Forming and Finishing subcategory wastewater discharges resulting from continuous electroplating of flat steel products (e.g., strip, sheet, and plate). EPA also relied on the Iron & Steel survey for financial and economic information on these 24 iron and steel facilities. EPA re-examined its database for facilities that perform continuous steel electroplating, and found that, contrary to its initial finding, continuous electroplaters do not perform operations similar to other facilities in this subcategory (i.e., steel forming and finishing facilities performing cold forming on steel wire, rod, bar, pipe, and tube). Thus, EPA included continuous electroplaters performing electroplating and coating operations in the General Metals subcategory for analyses supporting the final rule. As described in Section VI of the preamble to the final rule, EPA is not revising limitations or standards for any of these facilities. Such facilities will continue to be regulated by the General Pretreatment Standards (Part 403), local limits, permit limits, and Iron & Steel effluent limitations guidelines (Part 420), as applicable.

A.3.5 Municipality Survey

EPA distributed surveys in 1996 to city and county facilities that might operate facilities engaged in MP&M operations evaluated for the final rule. The Agency designed this survey to measure the rule's impact on municipalities and other government entities that perform maintenance and rebuilding operations on MP&M products (e.g., bus and truck, automobiles). The Agency sent the municipality survey to 150 city and county facilities randomly selected from the *Municipality Year Book-1995* based on population and geographic location. EPA allocated sixty percent of the sample to municipalities and 40 percent to counties. The 60/40 distribution was approximately proportional to their aggregate populations in the frame. EPA divided the municipality sample and the county sample into three size groupings as measured by population. The surveys collected information on costs of service and on the financial and economic characteristics of the governments operating these facilities.

A.3.6 Federal Facility Survey

EPA designed this survey to assess the impact of the MP&M effluent limitations guidelines and standards on federal agencies that operate MP&M facilities. EPA distributed the survey to federal agencies likely to perform industrial operations on metal products or machines. The Agency requested that the representatives of the seven chosen federal agencies voluntarily distribute copies of the survey to sites they believed performed MP&M operations. The information collected in the 1996 federal survey was identical to the long survey. After engineering review and coding, EPA entered data from 44 federal surveys into the database. Because EPA did not randomly select the survey recipients, data from these questionnaires were not used to develop national estimates.

A.3.7 POTW Survey

EPA distributed the Publicly-Owned Treatment Works (POTW) survey in November 1997. The Agency designed this survey to estimate possible costs and burden that POTWs might incur in administering MP&M permits or other control instruments and to estimate benefits from implementation of the options considered for the final rule. The Agency sent the POTW Survey to 150 POTWs with flow rates greater than 0.50 million gallons per day. EPA randomly selected the recipients from the 1992 Needs Survey Review, Update, and Query System Database (RUQus), and divided the POTW sample into two strata by daily flow rates: 0.50 to 2.50 million gallons, and 2.50 million gallons or more.

In addition to the total volume of wastewater treated at the site, the POTW Survey requested the number of industrial permits written, the cost to write the permits, the permitting fee structure, the percentage of industrial dischargers covered by National Categorical Standards (i.e., effluent guidelines), and the percentage of permits requiring specific administrative activities. EPA used this information to estimate administrative burden and costs. In addition, EPA requested information on the use or disposal of sewage sludge generated by the POTW. The Agency only required POTWs that received discharges from an MP&M facility to complete those questions. The POTW Survey requested the following sewage sludge information: amount

generated, use or disposal method, metal levels, use or disposal costs, and the percentage of metal loadings from MP&M facilities. The Agency used this information to assess the potential changes in sludge handling resulting from the MP&M rule and to estimate economic benefits of these options to the POTW.

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Appendix B: Cost Pass-Through Analysis

INTRODUCTION

This appendix presents the methodology and results from the analysis of **cost pass-through (CPT)** potential for 19 MP&M sectors.¹ This analysis consists of two parts:

1. an econometric analysis of the historical relationship of output prices to changes in input costs, and
2. an analysis of market structure characteristics.

These two analyses together provide a numerical estimate of how much of compliance-related cost increases a sector can be expected to pass on to its consumers.

The rest of this appendix is organized into the following six sections:

- ▶ B.1: Rationale for developing sector-specific CPT coefficients as opposed to firm-specific CPT coefficients;
- ▶ B.2: Econometric analysis of CPT potential, based on the historical changes in output prices relative to changes in input costs;
- ▶ B.3: Analysis of the market structure factors expected to affect cost recovery;
- ▶ B.4: Validation of econometric estimates of the CPT coefficients;
- ▶ B.5: Adjustment of estimated CPT coefficients to reflect the portion of an MP&M sector that will incur compliance costs; and
- ▶ B.6: Attachment: Findings from a review of the CPT literature.

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B.1 THE CHOICE OF SECTOR-SPECIFIC CPT COEFFICIENTS

EPA believes the use of sector-specific CPT coefficients instead of firm-specific CPT coefficients in the impact analysis is an appropriate and practical way of analyzing compliance CPT. The sector-wide rate provides an estimate of the change in each facility's output prices as a function of the regulation-induced increase in its production costs, *assuming that the same cost increase is experienced by all establishments competing with the facilities in question*. For MP&M sectors in which a large fraction of establishments will be affected by the regulation, it is reasonable to assume that the MP&M compliance cost acts

¹ The analysis of cost pass-through potential presented here refines in several places the methodology developed for the Phase I MP&M analysis. These refinements are highlighted at the appropriate stages of the discussion that follows.

like an industry-wide cost shock. As noted below in section five, EPA applies an additional adjustment to the estimated CPT rate to reflect the fraction of total sector output that is estimated to incur regulation-induced production cost increases.

In contrast to the concept of a sector-specific CPT adjustment, a firm-specific CPT rate relates a change in the prices charged by a specific firm to a change in its production costs, *assuming no change in the production cost for rival producers of that product*. Not surprisingly, previous studies have found that the CPT rate for changes on an individual firm's costs differs from the rate at which a firm would pass through cost changes that are common to all, or a substantial fraction of, firms in an industry (e.g., Ashenfelter et al., 1998). It is true, however, that firms in an industry will have differing CPT among each other to some extent for reasons such as, differentiated products (e.g., products of different firms are not commodities and are not perfectly substitutable); imperfectly competitive markets (e.g., markets in which individual firms possess different degrees of market power); and segmented markets (e.g., geographically segmented markets). In the presence of such imperfections, individual firms will very likely respond differently in their ability to pass on cost increases in higher output prices *even when the production cost increase applies to all, or a substantial fraction, of an industry's production*. Nonetheless, estimating the CPT ability of individual firms or sub-sector groups of firms within the MP&M sectors would require a detailed analysis of market segments and substitutability of MP&M products. While this effort may be theoretically possible, it would be highly expensive and an overall daunting challenge given the breadth of the MP&M industry sectors.

Therefore, this analysis of CPT potential in the MP&M industry is undertaken at the sector-specific level under the assumption of perfect competition in these sectors -- including product homogeneity (i.e., products produced by one firm are perfect substitutes for products produced by other firms), and homogeneity of production technology and cost across firms (i.e., pricing is at marginal cost).² Under these conditions, the price response to a general industry-wide change in production costs is likely to be industry-wide and similar across all firms.

B.2 ECONOMETRIC ANALYSIS

EPA performed an econometric analysis of input costs and output prices to estimate historical CPT elasticities for 18 of the 19 Phase I and Phase II MP&M Sectors. EPA could not estimate historical CPT coefficients for Aerospace due to data limitations. These elasticities indicate the changes in output prices by sector that have occurred historically in relation to changes in the cost of production inputs. Two factors determine the share of a cost increase that a facility can pass through to its customers: the elasticity of demand and the elasticity of supply in the facility's market. Both factors are difficult to measure accurately; among other reasons, observed changes in price are due to simultaneous changes in demand and supply. In view of this difficulty, this pass-through analysis does not decompose cost pass-through into the separate effects stemming from elasticity of demand and elasticity of supply.

An additional analytic challenge involves joint consideration of quantity and price effects. Specifically, the amount of cost increase that a firm may recover through a revenue increase may generally be decomposed into a change in price and a change in quantity sold. In most markets, increased prices (in response to increased costs) translate into reduced quantity of sales. The interaction of supply and demand elasticities determines whether or not total revenue increases.

For practical reasons, this analysis focused on *the change in equilibrium price* due to a change in input costs and further assumes that the sale quantities of businesses complying with the regulation do not change. The analysis determined changes in market quantities from closures rather than by estimating output changes in non-closing facilities. The analysis assumed that the quantity of shipments or sales does not vary with the increase in fixed and average costs unless the facility closes. The following grounds support this restriction:

- ***The cost model for the individual facility reflects a constant marginal cost relationship.*** The change in quantity of output at a facility is a function of the change in equilibrium price and the marginal cost relationship at the facility. For instance, in the case in which marginal cost increases with output, an upward shift in the marginal cost relationship due to compliance costs will generally cause a facility to reduce its production quantity. The extent of changes in production quantity will vary across facilities based on the shift in marginal cost and the rate at which marginal cost changes with production. Engineering analysis of facilities provides no information, however, about any change in the marginal cost relationship for a given facility, providing only lump-sum costs. In lieu of this information, the analysis uses constant marginal costs, which in turn means that

² These assumptions likely approximate the real world for those MP&M sectors that consist of a large number of small, highly competitive firms such as Job Shops or Printed Wiring Boards.

profit-seeking facilities will tend not to change their output quantities in response to added costs resulting from regulation. As a result, the only quantity-related decision that can be meaningfully analyzed at the facility level is whether to terminate production completely.

- ***An estimate of quantity response would be based on the aggregate industry response and would not be logically applicable to the facility-level analysis.*** An analysis can estimate quantity elasticity response to changes in input costs, but this value would represent the aggregate quantity response in the particular MP&M sector. The aggregate response encompasses a diversity of responses across facilities: a few facilities may eliminate production entirely while others may reduce, keep the same, or even increase output. Applying the aggregate quantity response to individual facilities while simultaneously allowing for terminated production would exaggerate the likely facility-level quantity response and the likelihood of facility closures. The current analysis simulates the aggregate response from a micro-analytic perspective: exiting facilities that found compliance to be an uneconomic proposition affect the industry-wide quantity response.

B.2.1 Framework

The analysis measured the sensitivity of equilibrium prices to changes in input costs. The “cost elasticity of price,” denoted E_p , measured the percentage change in output price per percent change in unit input costs.³ EPA estimated the cost elasticity of price by regressing annual output price indices on annual input price indices. The methodology’s direct estimation measured actual changes in output price with respect to changes in input costs. This practice took into account the full range of possible mechanisms by which input costs affect output prices, including technical changes, substitution, non-competitive pricing mechanisms, imperfect information phenomena, and any other shifts or irregularities in the supply and demand functions.

The 19 MP&M industry sectors encompass 224 industrial 4-digit SIC codes. EPA, however, could estimate the cost elasticity of price based on historical data for only 170 manufacturing SIC codes. EPA could not estimate the cost elasticity of price for Aerospace and non-manufacturing industries due to data limitations, but assigned a CPT coefficient to the aerospace sector based on the market structure analysis (see Section 2 for details, below).⁴ EPA assumed zero CPT for non-manufacturing industries because these industries tend to be very competitive.

For each MP&M sector, EPA estimated a relationship for the $k = 1$ to 10 yearly observations (from 1987 to 1996) by least-squares linear regression, as follows:

$$\ln(P_{out,k}) = \alpha + E_p \times \ln(P_{in,k-1}) + \epsilon \quad (B-1)$$

where:

$P_{out,k}$	=	price index for the bundle of goods produced by the MP&M sector, year k ;
E_p	=	elasticity of output price with respect to input costs for a given MP&M sector;
$P_{in,k-1}$	=	price index of inputs (labor and non-labor) to a given sector, year $k-1$;
b	=	elasticity of output price with respect to employment costs;
ϵ	=	error term; and
$\ln(x)$	=	natural log of x

Specifying the key regression variables as logarithms permitted EPA to estimate the elasticities of output prices with respect to the independent variables directly. That is:

³ The elasticity measure also applies to revenue because quantity of production is assumed constant.

⁴ Output Price Index data for the Aerospace sector were unavailable. EPA attempted to use proxy data for missile manufacturing, a component of the defense sector, to estimate a CPT coefficient for the Aerospace sector. This analysis did not produce meaningful results. The missile manufacturing industry witnessed a sharp decline in producer prices during the 1987-1996 time period, therefore yielding a negative CPT coefficient for the Aerospace sector. Since the Aerospace sector and the missile manufacturing industry are sufficiently different from each other, EPA decided not to use the estimated CPT coefficient and instead derive a coefficient for the Aerospace sector based solely on the market structure analysis.

$$E_p = \frac{d \ln(P_{out,k})}{d \ln(P_{in,k-1})} = \frac{d(P_{out,k})/P_{out,k}}{d(P_{in,k-1})/P_{in,k-1}}, \quad (B-2)$$

which is the elasticity of output price with respect to input cost changes in the previous year.

EPA's use of the logarithmic transformations also eliminated any linear trend over time; in effect, the individual yearly observations become cross-sectional variables. The model therefore required no specific time-series structure.

EPA considered additional independent variables that might aid in explaining output price changes. For example, EPA included some measures of aggregate income, but these measures did not contribute significantly to the estimated relationships.

The coefficients E_p from this regression are the estimated cost-elasticities of price for each MP&M sector. The estimated coefficients address the question: over the period of analysis, by how much did output prices change as input costs increased? The value of E_p for each sector, linked with other information on market structure, yielded a composite measure of cost pass-through potential by MP&M sector. As discussed below, EPA used the results of the market structure analysis to validate the estimated values of E_p , which represent the expected CPT potential for the different MP&M sectors. The validated E_p values are the CPT coefficients ultimately assigned to sectors for the economic/financial impact analysis.

B.2.2 Data Used to Estimate the Regression Equation

Estimating E_p required a measure of the change over time in input costs and a measure of the change in output price for each MP&M sector. EPA lagged output prices by a year because the market takes time to respond to price changes (i.e., input prices from 1988 would predict output prices in 1989). For example, exchange rate pass-through studies found the lags associate with price pass-through can extend from 5 to 8 quarters (J. Menon, 1995). EPA used data on changes of annual output price indices from 1987 to 1996 and input price indices from 1986 to 1995. The final data set contains ten years of data for each of the 18 industrial sectors of concern. The analysis estimated the relationship between change in output price index (dependent variable) and change in input cost index. The input cost index (independent variables) combines a wide range of non-labor cost values, including energy, with employment cost values.

a. Dependent variable

The dependent variable is the output price index. The **Producer Price Index (PPI)**, an appropriate measure of output price, measures changes in the price that the producer receives at the plant gate and is therefore the relevant price for the producer's production decisions. MP&M products are often intermediate goods whose market prices are producer prices. EPA estimated the dependent variable as the weighted average of PPIs for the goods produced by the industries in each sector.

EPA calculated the output price index for the sectors as follows:

$$P_{out,k} = \frac{\sum_i^N q_{i,k} \times PPI_{i,k}}{\sum_i^N q_{i,k}} \quad (B-3)$$

where:

- $P_{out,k}$ = average output price index value for a given MP&M sector in year k ;
- $q_{i,k}$ = value of shipments for SIC industry i , year k ; and
- $PPI_{i,k}$ = Producer Price Index for the output of SIC industry i , year k .

EPA used the following information to fill in data gaps for all output prices when the PPI series had missing data:

- ▶ Information at the 3-digit SIC code level if data were unavailable at the 4-digit SIC code level;
- ▶ The percentage change in price at the 3-digit level, applied to the 4-digit level to calculate missing values, if data at the 4-digit level were available for several years; and

- ▶ A best-fit line to extrapolate data for years with missing data when at least five years worth of data were available.

b. Independent variables

The independent variable is the input cost index. The input cost index averages the producer price index values for commodity inputs to the sector in question, weighted by the share of each input to sector output. The weighted average calculation involves two steps: (1) estimating input cost indices at the 4-digit SIC level and (2) developing the input cost index at the MP&M sector level. These steps are discussed in detail below.

❖ *Estimating Input Cost Indices at the 4-digit SIC level*

EPA first identified the composition of production inputs required to produce output from a given industry by obtaining direct requirement coefficients from the 1992 *Benchmark Input-Output Tables of the United States*.⁵ The direct requirement coefficients are defined as follows: for each dollar of output from industry i , the direct requirements coefficient r_j indicates the value of input j required to achieve one dollar of output from industry i . The sum of all requirements coefficients r_j for industry i equals one. Note that the direct requirements coefficients from the input-output table include information on the purchase of capital goods. Changes in the cost of capital goods are therefore reflected in the PPI series for the associated industries. Because only one set of direct requirements coefficients were available for and are used in the analysis, this analysis assumes that the input mix remains constant over the ten-year period considered in the analysis.

EPA then used yearly PPI values and the **Employment Cost Index (ECI)** from the Bureau of Labor Statistics to estimate changes in the labor and non-labor components of production cost over time. The Agency used ECI for private manufacturers to estimate changes in labor cost for all sectors except for aircraft manufacturing, for which a sector-specific ECI is available.

EPA calculated the input cost index for a 4-digit SIC group as a weighted average of prices for (a) all non-labor inputs for which the PPI series data were available and (b) labor input. The percentage of inputs accounted for in our regression model ranges from 39 percent to 100 percent, with an average of 66 percent.

To summarize, EPA calculated the input cost index as follows. For each 4-digit SIC industry, i , that uses non-labor inputs, j , the average input price for the year k is:

$$P_{i,k} = \frac{\sum_j r_j \times PPI_{j,k} + r_l \times ECI_k}{\sum_j r_j + r_l} \quad (B-4)$$

where:

$P_{i,k}$	=	average input price index for SIC industry i , year k ;
r_j	=	direct requirements coefficient for input commodity j by industry i ; and
$PPI_{j,k}$	=	Producer Price Index, commodity j , year k .
r_l	=	direct requirements coefficient for wages and salaries by industry i ; and
ECI_k	=	Employment Cost Index in year k .

❖ *Developing the input cost index at the MP&M sector level*

EPA developed the input cost index at the MP&M sector level by weighting the individual 4-digit SIC group cost index values by 4-digit SIC value of shipments from the *Census of Manufactures* and various *Annual Surveys of Manufactures* for the corresponding years. This analysis assumes that weights by production value are constants over time.

The resulting values provided an aggregate measure of input costs over the ten-year period 1986-1995 for each MP&M sector. For each MP&M industry sector, containing N 4-digit SIC industries, the average input price in each year k is:

⁵ The Bureau of Economic Analysis' Input-Output Table uses its own industry classification system, which is similar to the Standard Industrial Classification (SIC) used in the Economic Censuses. This discussion refers to that classification system as the BEA classification. Although the BEA classification has more categories than the SIC system, EPA grouped and mapped the BEA classification codes to the more aggregate SIC codes that form the MP&M sectors. EPA calculated an average price when one BEA input classification code corresponded to more than one SIC code.

$$P_{in, k} = \frac{\sum_i^N q_{i, k} \times P_{i, k}}{\sum_i^N q_{i, k}} \quad (B-5)$$

where:

- $P_{in, k}$ = average input price index value for a given MP&M sector in year k ;
 $P_{i, k}$ = input price index value for SIC industry i , year k ; and
 $q_{i, k}$ = value of shipments for SIC industry i , year k .

B.2.3 Regression Results

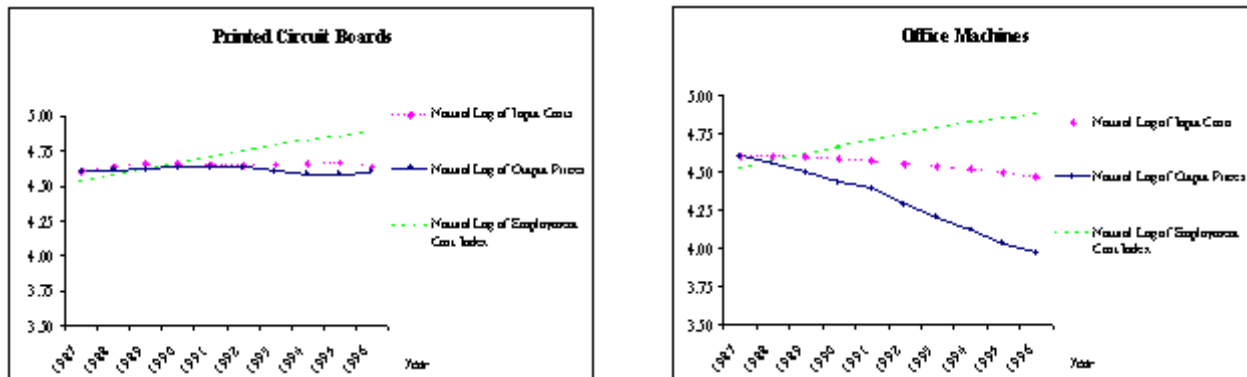
Table B.1 below gives the estimated parameter values (corrected for autocorrelation) and t-statistics for each of the sectors. Most of the estimated parameters have the expected sign and are statistically significant at 95th percentile. The estimated parameters show that 16 of the 18 MP&M sectors have been able to increase prices, at the margin, between 42 percent and 121 percent for every one percent increase in non-labor input costs. The estimated input cost coefficients are negative for two industrial sectors: Printed Circuit Boards and Office Machines. This finding suggest that additional market factors such strong domestic and global competition drive output prices down.

Figure B.1 below depicts output price and input cost trends from 1987 to 1996 for these two industries. It shows that in both sectors, output prices decreased faster than input costs. This difference indicates that significant competition in these sectors drives output prices down, undoubtedly through rapid technology innovation. An inverse relationship between labor cost and output prices also indicates presence of strong competition in these two sectors. Based on these findings, it is reasonable to assume that the printed circuit board and office machine sectors have zero CPT ability.

Table B.1: CPT Regression Results By Sector				
MP&M Sector	Regression Coefficients (t-statistics in parenthesis)			
	Phase 1 Proposed Rule (1982 to 1991)		Phase 2 Model (1987 to 1996)	
	Non-Labor Input Costs	Labor Input Costs	Intercept	Total Input Costs (Labor+Non-Labor)
Aerospace	.774 (12.73)	.001 (4.21)	N/A	N/A
Aircraft	.924 (37.22)	.003 (3.32)	-0.9280 (-1.45)	1.20 (8.90)
Bus & Truck	.930 (30.91)	.003 (2.46)	0.629 (1.00)	0.864 (6.52)
Electronic Equipment	.899 (25.28)	.005 (3.46)	2.79 (4.06)	0.395 (2.72)
Hardware	.889 (27.02)	.005 (3.68)	1.06 (1.80)	0.772 (6.22)
Household Equipment	.921 (43.03)	.003 (4.16)	1.69 (2.91)	0.636 (5.22)
Instruments	.923 (46.44)	.003 (4.34)	1.06 (1.79)	0.771 (6.18)
Iron and Steel	N/A	N/A	1.12 (1.57)	0.767 (5.14)
Job Shop	N/A	N/A	1.97 (3.33)	0.575 (4.61)
Mobile Industrial Equipment	.901 (23.94)	.004 (2.68)	0.546 (0.92)	0.884 (7.05)
Motor Vehicle	.898 (27.85)	.004 (3.36)	0.833 (1.03)	0.820 (4.76)
Office Machines	.920 (35.05)	.004 (3.52)	47.5 (17.2)	-9.33 (-15.6)
Ordnance	.907 (29.05)	.004 (3.18)	1.89 (3.63)	0.591 (5.41)
Other Metal Products	N/A	N/A	1.71 (3.04)	0.631 (5.34)
Precious Metals & Jewelry	.938 (24.82)	.002 (1.68)	1.69 (2.47)	0.640 (4.42)
Printed Circuit Boards	n/a	n/a	6.23 (9.07)	-0.337 (-2.31)
Railroad	.911 (30.52)	.004 (3.23)	0.548 (0.914)	0.881 (6.98)
Ships and Boats	.970 (34.68)	.001 (0.93)	0.817 (1.53)	0.823 (7.32)
Stationary Industrial Equipment	.909 (28.09)	.004 (3.06)	0.973 (1.78)	0.791 (6.88)

N/A = Not available from the Phase I analysis.

Source: U.S. EPA analysis

Table B.2: Output Prices and Unit Input Cost Trends in the Printed Circuit Board and Office Machine Sectors

Source: EPA Analysis.

Table B.1 also presents Phase 1 results for comparison. Note the following differences in the Phase 1 and Phase 2 analyses:

1. Time period:
 - ▶ Phase 1 analysis covers 1982 to 1991;
 - ▶ Phase 2 analysis covers 1987 to 1996.
2. Explanatory variables:
 - ▶ Phase 1 analysis included non-labor and labor cost variables separately. The model has no intercept term. Note that EPA then used only the non-labor input cost coefficient to estimate a CPT potential for a given sector;
 - ▶ Phase 2 analysis combines labor and non-labor input costs because compliance costs are associated with both. The intercept term captures additional market trends (e.g., increased import penetration) not reflected in the input cost indices.
3. Industrial sectors:
 - ▶ Phase 1 analysis included 15 industrial sectors. It excluded iron and steel, job shops, other metal products, and printed circuit boards industries;
 - ▶ Phase 2 analysis includes 18 of the 19 industrial sectors and excludes the aerospace industry. The Phase 1 analysis included aerospace, but EPA used proxies from the aircraft industries to estimate output price indices for the aerospace-related 4-digit SICs. EPA now estimates the CPT potential for this sector based on the market structure analysis alone.

EPA assigned MP&M sectors to low, average, and high CPT categories based on the natural breaks in the estimated parameter values. The estimated parameter values exhibit two distinct breaks in their distribution, between Precious Metals and Jewelry (65.89 percent) and Hardware (78.17 percent) and between Motor Vehicle (82.45 percent) and Railroad (88.49 percent). EPA added the Aerospace sector to the high CPT category based on results from the market structure analysis. Table B.3 summarizes results from this analysis.

Table B.3: Classification of MP&M Sectors by CPT Ability		
Low CPT	Average CPT	High CPT
Office Machine	Hardware	Railroad
Printed Circuit Boards	Instruments	Mobile Industrial Equipment
Electronic Equipment	Iron & Steel	Bus & Truck
Job Shop	Stationary Industrial Equipment	Aircraft
Ordnance	Ships & Boats	Aerospace ^a
Other Metal Products	Motor Vehicle	
Household Equipment		
Precious Metals & Jewelry		

^a Aerospace assigned to *High* category based on results from the market structure analysis (discussed in the next section).

Source: U.S. EPA analysis

B.3 MARKET STRUCTURE ANALYSIS

The second part of the analysis of cost pass-through potential is based on an analysis of the current market structure of the MP&M industry sectors. Information on the competitive structure and market characteristics of an industry provide insight into the likely ranges of supply and demand elasticities and the sensitivity of output prices to input costs. For example, when input costs increase, the profit-maximizing firm attempts to maintain its profits by increasing output prices accordingly. The amount of the cost increase that the firm can pass on as higher prices depends on the relative market power of the firm and its customers. The market structure analysis described in this section attempts to measure the relative market power enjoyed by firms in each MP&M sector and provides ordinal rankings used to validate the CPT coefficients estimated by the econometric analysis. The analysis represents the current market structure and CPT ability of firms in the MP&M sectors and in no way attempts to forecast the future market structure of these sectors.

B.3.1 Measures Descriptions

The following discussion describes five indicators of market power used to assess cost pass-through potential for the 19 MP&M sectors. Only manufacturing firms have been considered; non-manufacturing firms have been excluded due to data limitations. As noted above, EPA assigned zero CPT ability to non-manufacturing firms. The five indicators of market power analyzed are : the eight-firm concentration ratio, import competition, export competition, long term growth, and competition barriers. Each of these factors are discussed in detail below.

a. Concentration

The extent of concentration among a group of market participants is an important determinant of that group's market power. A group of many small firms typically has less market power than a group of a few large firms, because the latter are in a more advantageous position to collude with each other. All else being equal, highly-concentrated industries are therefore expected to pass-through a higher proportion of the compliance costs that will result from this regulation.⁶

This analysis uses the eight-firm concentration ratio, which measures the percentage of the value of shipments concentrated in the top eight firms in each four-digit SIC category, as an indicator of market concentration. The analysis estimates sector concentration ratios as the weighted averages of component industry concentration ratios, weighted by SIC value of shipments.⁷ An increase in the sector concentration ratio makes firms in an industry better able to pass on larger portions of their input cost increases without adversely affecting quantities sold to a significant extent.

⁶ A substantial body of empirical research exists that has addressed the relationship between industry concentration and market power. Eg, see Waldman & Jensen, 1997.

⁷ The eight-firm concentration ratio and value of shipments data used are for the year 1992.

This analysis is potentially limited by the necessity to aggregate component industries into sectors. The accuracy of any analysis to characterize market power originating from industry concentration depends to a great extent on defining the relevant market. A well-defined market requires including all competitors and excluding all non-competitors. Defining the relevant market too narrowly overstates market power, while defining the market too broadly would underestimate it. Aggregating concentration ratios for the four-digit SIC categories into a sector concentration ratio results in a sector average that may overstate market power for some portions of the sector and understate market power for other portions. This analysis would likely estimate concentration ratios for markets that in general are too broadly-defined.⁸ Even so, the sectoral concentration ratios estimated should provide meaningful information that will assist in determining relative market power for each sector, because firms producing similar or related products are still classified within the same sector and each sector produces a distinctly different family of products (e.g., motor vehicles, aircrafts, ships and boats).

Another important determinant of the relevant market is its geographical extent. Given the nature of the MP&M industry, however, this factor is not important because it pertains more to industries dealing with perishable commodities and those with high transportation costs.

b. Import competition

Theory suggests that imports as a percent of domestic sales are negatively associated with market power because competition from foreign firms limits domestic firms' ability to exercise such power. Firms belonging to sectors in which imports make up a relatively large proportion of domestic sales will therefore be at a relative disadvantage in their ability to pass-through costs compared to firms belonging to sectors with lower levels of import penetration, a measure of import competition. Import penetration, the ratio of imports in a sector to the total value of domestic consumption in that sector, is particularly significant because foreign producers will not incur costs as a result of this regulation.

In the market structure analysis, higher import penetration generally means that firms are exposed to greater competition from foreign producers and will thus possess less market power to increase prices in response to regulation-induced increases in production costs. The Census Bureau provides import data at the four-digit SIC level. EPA estimated sector import penetration ratios as the ratio of the sum of component industry imports divided by the sum of component industry value of domestic consumption⁹.

c. Export competition

The MP&M regulation will not increase the production costs of foreign producers with whom domestic firms must compete in export markets. As a result, sectors that rely to a greater extent on export sales will have less latitude in increasing prices to recover cost increases resulting from regulation-induced increases in production costs. They will therefore have a lower CPT potential, all else being equal.

This analysis uses export dependence, defined as the percentage of shipments from a sector that is exported, to measure the degree to which a sector is exposed to competitive pressures abroad in export sales. EPA used export data at the four-digit SIC level and derived sector export dependence ratios: the sum of component industry exports divided by the sum of component industry value of shipments.

That domestic producers export a substantial share of their product does not necessarily imply that they are subject to greater competitive pressures abroad compared to what they face in domestic markets. Such would be the case in sectors where U.S. producers are the dominant suppliers worldwide. To account for this possibility, EPA analyzed in more detail those sectors showing high export dependence to see if domestic firms in those sectors appear to dominate the world market.¹⁰ Based on information presented in the profile of MP&M industry profile, EPA determined that firms in all four of these sectors (i.e., precious metals and jewelry, ordnance, office machine, and aircraft) operate in highly competitive international markets. The conventional theory that higher export dependence results in relatively lower market power is therefore assumed to hold true for all MP&M sectors.

⁸ The four-digit SIC category, while not a perfect delineation, is most often used by industrial organization economists in their studies because, among publicly available data sources, these industries appear to correspond most closely to economic markets (Waldman & Jensen, 1997).

⁹ Census data on imports, exports, and value of shipments for the year 1996 were used for estimating this and the next market structure indicator.

¹⁰ EPA considered sectors with export dependence exceeding 30 percent for this part of the analysis.

A substantial body of literature studies the link between environmental regulation and competitiveness in international trade. Overall, little empirical evidence seems to support the hypothesis that environmental regulations have had a significant adverse effects on the international competitiveness of domestic firms (Jaffe et al., 1995). Nonetheless, export dependence as an important independent factor in assessing the validity of the estimated CPT coefficients. If historical changes in input costs have affected both domestic and foreign firms more or less uniformly, then the econometrically estimated E_p would not address situations in which only domestic firms face higher costs. Determining the exact extent to which changes in input costs have affected both domestic and foreign producers uniformly is beyond the scope of this analysis. Such changes, however, can affect a significant proportion of cost changes related to the non-environmental aspect of inputs, such as those for energy, imported raw materials, and imported manufactured inputs.

Given the above, European and other developed countries have also implemented strict environmental regulations comparable to U.S. regulations; even changes in environmental costs have therefore often been relatively uniform across domestic and foreign firms. This uniformity may account for the fact that past studies do not show substantial impacts of U.S. environmental regulation on the balance of trade.

Because this regulation will affect only domestic firms, and the analysis assumes that no similar regulatory response is expected in foreign countries at least in the short term, domestic firms will face relatively higher production costs compared to their international competitors as a result of regulation. To study the impact of *this* regulation on the change in MP&M industry competitiveness in international markets, the market structure analysis must therefore include measures that assess the effect of each sector's dependence on export markets on its ability to pass through costs.

d. Long-term industry growth

An industry's competitiveness and the ability of firms to engage in price competition are likely to differ between declining and growing industries. Most studies have found that recent growth in revenue is positively related to profitability (Waldman & Jensen, 1997), which suggests a greater ability to recover costs fully.

Based on Census Bureau data, EPA estimated the average growth rate in the value of shipments between 1988 and 1996 for each sector, with the value of shipments for each component industry also serving as the weights for deriving average sector growth rates. EPA expects firms in sectors with higher growth rates to be better positioned to pass through compliance costs rather than being forced to absorb such cost increases in order to retain market share and revenues.

e. Competition barriers

Barriers to entry and exit help a concentrated industry exert market power by deterring potential competitors from entering the market. Without these barriers, a firm that tries to pass through compliance costs by raising its prices risks losing its market share to new firms that see an opportunity to compete at higher prices.

- ▶ **Entry barriers** are the fixed costs of beginning business in an industry. Entry barriers include high capital costs, brand name reputations that require a large advertising expense to overcome, a long learning curve, and any other factors that make the costs for new entrants higher than the costs of existing firms.
- ▶ **Exit barriers** are the fixed costs that cannot be salvaged upon leaving the industry. They are sometimes called **sunk costs** and are measured as the difference between the replacement value of a facility's capital and its liquidation value. Exit barriers include factors that make it difficult for a firm to liquidate its assets, such as specialized machinery that cannot be sold or converted to alternative uses, brand names that cannot transfer well to other products, or substantial shutdown liabilities that would offset the value of assets in liquidation. The capital valuations are typically needed to measure exit barriers.

An analysis measuring entry and exit barriers can avoid problems of data availability by identifying directly the presence of above-normal profits that such barriers would permit. This analysis uses a sector's **risk-normalized return on assets (ROA)** as an indicator of profit rates and the likely presence of entry and exit barriers. A popular measure used by managers for measuring firm performance, the ROA is used as an indicator of firm profitability. This analysis estimates an ROA before interest payments and taxes to compare firms with different capital structures. Using the pre-tax ROA results in the *adding back* of the interest tax shield and permits comparing ROAs among firms assumed to be entirely equity-financed. The analysis measures firm riskiness by the Asset Beta, which is the firms' Equity Beta (i.e., measure of the firm's riskiness as an investment relative to the market for equity investments as a whole), adjusted to remove their financing decision from the beta calculation. With this adjustment, the analysis can compare firms with different capital structures because the Asset Beta represents the beta of common stock had the firm been entirely equity-financed.

The **Capital Asset Pricing Model (CAPM)** states that the expected risk premium on an investment (return earned over and above the risk-free rate) reflect investment's riskiness relative to the market (beta). The Treynor Ratio, a commonly used performance measure that uses betas as a measure of risk, embodies this principle of the CAPM:

$$\text{Treynor Ratio} = (\text{Return from Investment} - \text{Risk Free Interest Rate}) / (\text{Beta of Investment})$$

For this analysis, however, the Treynor Ratio, or any other performance measure requiring estimation of the risk premium on an investment, could not be used. More than 60 percent of the firms in the analysis had five year, pre-tax ROAs that were lower than the risk-free interest rate of 5.21 percent (return on the three-month U.S. Treasury Bill for the five-year period 1996-2000). The analysis using the Treynor Ratio yielded results that did not permit a meaningful comparison of risk-normalized ROAs among sectors. This analysis therefore used a modified form of the Treynor Ratio that adjusts the total return and not just the risk premium by the riskiness of an investment. Applying this modification, the analysis estimated the risk-normalized ROAs as follows:

$$\text{Risk-Normalized ROA} = \text{ROA} / \text{Asset Beta}$$

The analysis estimated risk-normalized ROAs for sectors using firm level data as opposed to data at the 4-digit SIC level, and identified firms belonging to each MP&M sector using a two step process:

- ▶ First, EPA assigned facilities (and their parent firms) responding to the MP&M facilities survey to the sector from which they received the largest portion of their revenues.
- ▶ Second, EPA identified additional facilities belonging to each sector using a financial information Web site (marketguide.com), which provides a classification of publicly-traded firms by the 4-digit SIC code of their largest business segment based on revenues.

EPA estimated ROA and Beta values for a five-year time period, and estimated sector risk-normalized ROAs by weighting each firm's risk-normalized ROA by its market capitalization.¹¹

The use of the risk-normalized ROA measure only assigns MP&M sectors relative rankings and does not imply that they face high or low barriers to competition in absolute terms. The analysis assumes that higher risk-adjusted profits in general indicate potential entry and exit barriers and above average market power.

¹¹ EPA further studied the business activities of firms belonging in the MP&M facilities survey that were identified as conglomerates or found to own multiple facilities belonging to more than one MP&M sector, and of firms in the broader sample having a market capitalization exceeding \$25 billion. This additional step ensured that the market capitalization weight used in the analysis represented only the fraction of revenues that the firm receives from its business activities in the MP&M sector(s) of interest.

B.3.2 Results

EPA used these five indicators to assign each sector a cost pass-through score. Higher numerical values indicate greater CPT potential for some indicators (e.g., industry concentration) and lesser CPT potential for others (e.g., import competition). Table B.4 summarizes the specific ranking definitions for each indicator.

Table B.4: Summary of Ranking Rules for Assessing Relative Pass-Through Potential Based on Market Structure Considerations^a		
	Variable Indicates Greater Pass-Through Potential (High Rank)	Variable Indicates Lesser Pass-Through Potential (Low Rank)
8-Firm Concentration Ratio	Greater than median	Lesser than median
Ratio of Imports to Shipments	Lesser than median	Greater than median
Ratio of Exports to Shipments	Lesser than median	Greater than median
Average Growth Rate of Shipments	Greater than median	Lesser than median
Risk-Normalized Pre-Tax Return on Assets	Greater than median	Lesser than median

^a All assessments of pass-through potential are relative among the 19 MP&M Sectors.

Source: U.S. EPA analysis.

For each of the five indicators, EPA ranked sectors from 1 to 19, with 1 assigned to the sector assessed to have the lowest CPT potential and 19 assigned to the sector assessed to have the highest CPT potential.¹² Based on this scoring system, the possible score for a sector when all five of its ranks are summed ranges from 5 to 95. Table B.5 presents a summary of the results for the market structure analysis.

¹² This ranking scale differs from the scale used to assign scores in the market structure analysis undertaken for the Phase I MP&M analysis. In the Phase I analysis, depending on the variable under consideration, a sector received a value of +1 if it indicated a greater CPT potential relative to the median and a value of -1 if it indicated a lesser CPT potential relative to the median. The sector at the median received a value of 0. The use of the median value as the threshold for determining relatively higher or lower (+1 or -1) market power was somewhat arbitrary, especially for values closely centered around the median. The new scale, since it considers individual sector ranks, is superior because it explicitly recognizes that extreme values are more likely to be indicative of high or low market power, and accordingly assigns them a higher or lower score. For example, the old scale would assign a sector with industry concentration just above the median (e.g., other metal products) the same score of +1 as a very highly-concentrated industry, such as aerospace. The new scale, however, recognizes the difference in industry concentration between the two sectors and therefore assigns the first sector a rank close to 10 and aerospace a rank close to 19.

Table B.5: Results of the Market Structure Analysis^a

Overall Rank	Sector	8-firm Concentration Ratio		Import Penetration (%)		Export Dependence (%)		Avg. Annual Growth Rate (%)		Risk-Normalized ROA (%)		Aggregate Score
		Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	
1	Precious Metals and Jewelry	35.0	4	77.36	1	49.85	2	-1.9	3	14.43	10	20
2	Printed Circuit Boards	35.0	3	21.99	8	17.07	10	1.5	8	7.50	2	31
3	Ordnance	76.90	16	18.92	10	50.17	1	-7.3	2	12.30	6	35
4	Household Equipment	54.22	10	33.18	3	17.02	11	1.5	9	12.02	5	38
4	Office Machine	61.38	14	51.85	2	43.41	4	3.1	15	9.58	3	38
6	Electronic Equipment	47.27	9	24.55	6	24.04	6	5.1	18	7.21	1	40
7	Aircraft	85.3	18	22.74	7	46.43	3	-1.7	4	16.15	13	45
8	Iron and Steel	41.87	6	4.54	16	1.32	17	0.4	6	11.38	4	49
9	Other Metal Products	54.27	11	32.40	4	17.57	9	1.1	7	26.60	19	50
10	Stationary Industrial Equipment	41.16	5	17.71	11	23.64	7	3.7	16	16.78	14	53
11	Hardware	24.52	2	14.31	14	11.37	13	2.1	11	17.18	15	55
12	Instruments	44.2	8	15.33	12	23.07	8	1.8	10	19.64	18	56
13	Mobile Industrial Equipment	58.56	13	21.42	9	29.62	5	2.8	13	18.13	17	57
14	Ships and Boats	58.20	12	6.49	15	6.48	15	-1.5	5	16.11	12	59
15	Job Shop	19.26	1	0.00	19	0.00	19	3.1	14	13.44	9	62
15	Motor Vehicle	77.30	17	27.56	5	15.74	12	2.6	12	18.10	16	62
17	Aerospace	92.29	19	0.75	18	0.75	18	-7.6	1	13.19	8	64
17	Bus & Truck	42.51	7	2.86	17	3.04	16	4.8	17	12.31	7	64
19	Railroad	71.00	15	15.16	13	10.26	14	7.6	19	14.62	11	72

^a Shaded values are the medians for each market structure indicator.

Source: U.S. EPA analysis

This rank scoring system has some important limitations:

1. This grading scale implicitly assigns equal weights to each of the five market structure indicators. Clearly, the impact of each of these five indicators on market power will vary from sector to sector, and some indicators are likely to dominate others within each sector.
2. Although the ranking scale distinguishes between sectors with extreme values and those that are close to the median, it does not permit an accurate judgement about how significant a particular value may be in determining market power. For each indicator, sectors are simply ranked from 1 to 19 based on the lowest to highest market power potential. The change in market power expected as one moves from sector 1 to sector 5 is not likely to be equal, however, to the change in market power expected as one moves from sector 6 to sector 10.

In general, the market structure analysis revealed that a discernable gap exists in the estimated parameters around rank 4/5 and around rank 14/15 for most indicators (see Table B.6). For each indicator, two small groups, each containing about four to

five sectors, therefore seem to have relatively low and high market power. A much larger group of about nine to ten sectors exhibit average market power.

Table B.6: Distribution of Estimated Parameters for Market Structure Variables					
Rank	8-firm Concentration Ratio	Import Penetration	Export Dependence	Average Annual Growth Rate	Risk-Normalized ROA
1	19.26	77.36%	50.17%	-7.6%	7.21
2	24.52	51.85%	49.85%	-7.3%	7.50
3	35.00	33.18%	46.43%	-1.9%	9.58
4	35.07	32.40%	43.41%	-1.7%	11.38
^a	41.16	27.56%	29.62%	-1.5%	12.02
6	41.87	24.55%	24.04%	0.4%	12.30
7	42.51	22.74%	23.64%	1.1%	12.31
8	44.22	21.99%	23.07%	1.5%	13.19
9	47.27	21.42%	17.57%	1.5%	13.44
10 ^a	54.22	18.92%	17.07%	1.8%	14.43
11	54.27	17.71%	17.02%	2.1%	14.62
12	58.20	15.33%	15.74%	2.6%	16.11
13	58.56	15.16%	11.37%	2.8%	16.15
14	61.38	14.31%	10.26%	3.1%	16.78
15 ^a	71.00	6.49%	6.48%	3.1%	17.18
16	76.90	4.54%	3.04%	3.7%	18.10
17	77.30	2.86%	1.32%	4.8%	18.13
18	85.32	0.75%	0.75%	5.1%	19.64
19	92.29	0.00%	0.00%	7.6%	26.60

^a Highlighted rows mark the natural gaps in the various indicators.

Source: U.S. EPA analysis

The aggregate market structure scores for all sectors range from a low of 19 to a high of 71. Apart from the lowest score (precious metals and jewelry) and the highest score (railroad), all the other scores are uniformly distributed with no clear breaks in their distribution that can be used for classifying sectors by their CPT potential (see Table B.5). EPA therefore used an alternative classification system for the market structure analysis. Based on the average aggregate score of 50 (average rank of 10), EPA assigned sectors with an aggregate score of 40 or below (average rank of 8 or less) to the low CPT category, and assigned sectors with an aggregate score of 60 or above (average rank of 12 or more) to the high CPT category. EPA assigned sectors with aggregate scores between these cutoffs to the average CPT category. Table B.7 shows the categorization of all 19 sectors by their CPT potential based on this classification system. In total, EPA classified six, eight, and five sectors in the low, average, and high CPT categories, respectively. The classification cutoffs, though somewhat arbitrary, result in a sector classification similar to the trends witnessed for most individual indicators, such that about five sectors are classified in the low and high CPT categories and the remaining sectors are classified as having average CPT potential.

Table B.7: Classification of MP&M Sectors by CPT Ability

Low CPT	Average CPT	High CPT
Precious Metals & Jewelry	Aircraft	Job Shop
Printed Circuit Boards	Iron & Steel	Motor Vehicle
Ordnance	Other Metal Products	Aerospace
Household Equipment	Stationary Industrial Equipment	Bus & Truck
Office Machine	Hardware	Railroad
Electronic Equipment	Instruments	
	Mobile Industrial Equipment	
	Ships & Boats	

Source: U.S. EPA analysis

Although recognizing the limitations of the ranking scale, EPA believes that it is useful for presenting the results succinctly and provides a basis for validating the estimated CPT coefficients. Analyzing the relative importance of each indicator for each of the sectors is beyond the scope of this analysis.

B.4 VALIDATION OF ECONOMETRICALLY-ESTIMATED CPT COEFFICIENTS

The econometric analysis provides a quantitative assessment of what the cost pass-through ability of each sector *appears* to be. The market structure analysis yields a judgment of what the pass-through ability of each sector *ought* to be. In this section the two analyses are brought together, with the results of the market structure analysis used to validate the CPT coefficients estimated by the econometric analysis.

Table B.8 shows a comparison of each sector's CPT classification based on the econometric analysis and the market structure analysis. The two analyses classify 13 of the 19 sectors in the same CPT category. For these sectors, the market structure analysis appears to validate the CPT coefficient derived using the econometric analysis. No econometric estimate is available for one sector (aerospace); for this sector, EPA used only the market structure analysis. For the remaining five sectors, however, the two analyses assign sectors to different CPT categories. EPA undertook a more detailed analysis of these sectors' market structure to validate their CPT coefficient. Specifically, EPA examined the following two factors affecting firm's market power in a given industrial sector:

- ▶ Whether any (i.e., one or more) of the five structural indicators may be extremely important or irrelevant for a particular sector, and therefore whether its effect on market power is being under-weighted or over-weighted, respectively.
- ▶ Whether other factors affecting market power for these sectors have not been included in the market structure analysis, but which possibly have substantial effects on market power/CPT ability in particular sectors.

The discussion below summarizes EPA's review and conclusions for each of these six sectors.

Table B.8: Comparison of Sectoral Classification Based on Econometric and Market Structure Analysis		
Sector	Econometric Analysis	Market Structure Analysis
<i>CPT Categorization Matches</i>		
Electronic Equipment	Low	Low
Household Equipment	Low	Low
Office Machine	Low	Low
Ordinance	Low	Low
Precious Metals and Jewelry	Low	Low
Printed Circuit Boards	Low	Low
Hardware	Average	Average
Instruments	Average	Average
Iron and Steel	Average	Average
Ships and Boats	Average	Average
Stationary Industrial Equipment	Average	Average
Bus & Truck	High	High
Railroad	High	High
<i>CPT Categorization Does Not Match</i>		
Other Metal Products	Low	Average
Job Shop	Low	High
Motor Vehicle	Average	High
Aircraft	High	Average
Mobile Industrial Equipment	High	Average
<i>CPT Comparison Not Possible</i>		
Aerospace	N/A	High

Source: U.S. EPA analysis.

B.4.1 Other Metal Products

This sector is assigned to the *low* category by the econometric analysis and the *average* category by the market structure analysis. EPA believes that the estimated CPT coefficient for this sector is accurate and that the market structure score for this sector is somewhat misleading because of the exceptionally high risk-normalized ROA derived for it. A priori, there appears to be no reason why firms in this sector should be able to earn significantly higher returns than in other sectors, and the high risk-normalized ROA estimated is likely an artifact of the small sample of firms for which financial data were available to estimate risk-normalized returns for this sector. The other four indicators of market power suggest below-average CPT for this sector, which agrees with the CPT coefficient estimated from the econometric analysis.

B.4.2 Job Shops

EPA assigned this sector to the *low* category by the econometric analysis and the *high* category by the market structure analysis. EPA believes that the market structure analysis may be misleading due to the high CPT ranks assigned to the Import Penetration and Export Dependence indicators of market power for this sector. These two indicators of market power are not relevant for this sector, however, because the sector is not trade-oriented. EPA expects the level of domestic competition among job shops to be the single most important factor that determines market power and the ability of firms to pass through costs in the sector. The Job Shop sector has the lowest concentration ratio among all the sectors, suggesting that the sector is characterized by a substantial number small firms (see Table 3.8 in the MP&M Industry Profile) that are most likely engaged

in intense competition among each other. The estimated, *low*, CPT coefficient for this sector therefore appears to be appropriate.

B.4.3 Motor Vehicle

This sector is assigned to the *average* category by the regression analysis and the *high* category by the market structure analysis. EPA believes that this sector is characterized by average cost pass-through potential due to the extremely competitive nature of the motor vehicle industry both domestically and in international markets. In recent years, in a bid to remain or become more competitive, the trend in this industry has been towards the continual consolidation of firms into globalized manufacturers. In fact, motor vehicle manufacturers are no longer constrained within national boundaries, as mergers and joint ventures include some of the largest firms from different countries. In addition, manufacturers have increasingly standardized the design of motor vehicles and their parts, changes that have resulted in much less product differentiation (but greater product quality) among manufacturers. The increasing intensity of global competition and the move towards decreasing product differentiation are likely to limit the ability of domestic producers to pass-through significant portions of their cost increases associated with this regulation. Therefore, the finding of an average cost pass-through coefficient appears to be justified.

B.4.4 Aircraft

This sector is assigned to the *high* category by the econometric analysis and the *average* category by the market structure analysis. Based on the unique nature of the global aircraft industry, EPA believes that the estimated CPT coefficient for this sector is appropriate. Not only is the industry concentrated domestically (concentration ratio of 85.3), but this is also true of the global aircraft manufacturing industry. In recent years, the industry has witnessed substantial restructuring through mergers and consolidation, both nationally and internationally (see section 3.2.2 in the MP&M Industry Profile). The highly concentrated nature of the industry, combined with the sizeable share of the domestic market that is controlled by domestic aircraft manufacturers, suggests that firms in this sector have the ability to pass through a significant portion of their cost increases.

B.4.5 Mobile Industrial Equipment

EPA assigned this sector to the *high* category by the econometric analysis and the *average* category by the market structure analysis. EPA believes that this sector is more appropriately characterized by *average* CPT because the sector has witnessed certain trends in recent years that suggest that firms in this sector do not have a *high* ability to pass through cost increases. Specifically, growth rates in the construction and the farm and machinery equipment industries started to level off or even declined in recent years after a sustained period of growth (see section 3.2.10 in the MP&M Industry Profile). These declining trends are not fully represented in the regression analysis because the last year of analysis is 1996. EPA therefore revised the CPT coefficient for this sector to equal the average CPT value for all sectors classified in the *average* category based on the regression analysis.

B.4.6 Aerospace

Since the market structure analysis categorizes the Aerospace sector in the *high* CPT category, EPA estimated the CPT coefficient for this sector as the average CPT value for all sectors classified in the *high* category based on the regression analysis (excluding Mobile Industrial Equipment whose CPT coefficient was revised based on the market structure analysis).

B.5 ADJUSTING ESTIMATES OF COMPLIANCE CPT POTENTIAL

The CPT values estimated above reflect sector level CPT potential. The methodology must consider that ability to pass on cost increases through price increases will differ at the industry level versus the facility level. Cost increases that affect all facilities in an industry are more likely to be recovered through industry-wide price increases, whereas cases where only a few facilities in an industry incur cost increases are less likely to result in price increases. This analysis must therefore take into account the proportion of an industry that will experience cost increases when applying industry-level cost pass-through coefficients.

For the final MP&M rule, EPA will use the method used in the Phase I analysis where EPA adjusted the industry-level cost pass-through coefficient downward in proportion to the percentage of sector output bearing compliance cost. The ratio of the revenues in water-discharging facilities affected by the rule divided by total revenues in the MP&M sector provided a measure of the fraction of production in the MP&M sector likely to be affected by cost increase. That is, a cost pass-through percentage of 90 percent would be reduced to 72 percent if 80 percent of the sector output was subject to the regulation ($.80 \times .90 = .72$). EPA applied this adjusted pass-through percentage to the percentage cost increase experienced by the regulated facilities only (i.e., sum of compliance costs divided by the sum of baseline costs for the facilities subject to the rule). Table B.9 presents the adjusted CPT coefficients estimated for each sector.

Sector	Unadjusted Cost Pass-Through Potential	Estimated Fraction of Sector's Revenue Subject to Regulation (%)	Adjusted Cost Pass-Through Potential
Aerospace ^a	0.98	100.00	1.00
Aircraft ^b	1.20	100.00	1.00
Bus & Truck	0.86	100.00	0.96
Electronic Equipment	0.39	100.00	0.42
Hardware	0.77	33.50	0.26
Household Equipment	0.64	100.00	0.64
Instruments	0.77	100.00	0.77
Iron and Steel	0.77	100.00	0.77
Job Shop	0.57	43.70	0.25
Mobile Industrial Equipment ^c	0.79	100.00	0.79
Motor Vehicle	0.82	44.10	0.36
Office Machines ^d	(9.33)	34.50	0.00
Ordnance	0.59	100.00	0.59
Other Metal Products	0.63	100.00	0.63
Precious Metals & Jewelry	0.64	42.90	0.27
Printed Circuit Boards	(0.34)	53.60	0.00
Railroad	0.88	100.00	0.88
Ships and Boats	0.82	100.00	0.82
Stationary Industrial Equipment	0.79	32.20	0.25

^a CPT coefficient for the Aerospace sector estimated based on the market structure analysis.

^b For the Aircraft sector, the cost-pass through potential is capped at 100%.

^c CPT coefficient for the Mobile Industrial Equipment sector revised based on the market structure analysis.

^d For the Office Machine and Printed Circuit Boards sectors, the cost-pass through coefficients are set to zero based on both the estimated negative regression coefficient and the results of the market structure analysis.

Source: U.S. EPA analysis

ATTACHMENT B.A: SELECTED REVIEW OF CPT LITERATURE

To support the CPT analysis, EPA undertook a selected review of previous CPT analyses. The two most studied areas in the literature deal with exchange rate pass-through and tax pass-through. Unfortunately, neither of these study types is useful in assessing the reliability of the MP&M CPT results. Sections B.A.2 and B.A.3 provide a brief summary of these studies. One study (Ashenfelter et al., 1998) estimates the pass-through rate for cost changes faced by an individual firm and compares it with pass-through of cost changes common to all firms in an industry. This appears to be the most relevant to the analysis of compliance costs pass through. Section B.A.1 provides a brief summary of findings from this study.

B.A.1 Ashenfelter et al. (1998), "Identifying the Firm-Specific Cost Pass-Through Rate."

As noted above, Ashenfelter et al. (1998) examines the pass-through rate for cost changes faced by only an individual firm (Staples, an office superstore chain), and distinguishes that rate from the rate at which a firm passes through cost changes common to all firms in an industry. Based on their analysis, they find the combined firm-specific and industry-wide pass-through rate (i.e., with no distinction between cost changes specific to the individual firm and those applicable to the entire industry) to be 57 percent. Conversely, the pass-through rate estimated for only firm-specific cost changes is about 15 percent and the pass-through rate for only industry-wide cost changes is close to 85 percent. The finding of a high CPT rate for industry-wide cost changes lends support to EPA's finding of similarly high historical CPT rates for many of the MP&M sectors.

B.A.2 Exchange Rate Pass-Through

The exchange rate pass-through literature examines the response of local currency import prices to variation in the exchange rate between exporting and importing countries. Based on seven studies covering the period 1970 to the mid-1980s, Menon (1995) finds that the estimated aggregate pass-through of exchange rate changes to import prices ranges from a low of 48.7 percent to a high of 91 percent. The mean value for pass-through for the sample of studies he considered is 69.9 percent. In contrast, Feinberg (1989) considers the impacts of exchange rate movements on U.S. domestic prices and finds an average pass-through of 16 percent in real terms. The pass-through is close to complete for industries that are heavily reliant on imported inputs and producing goods highly substitutable for imports. Pass-through rates are much lower for capital-intensive and concentrated industries and those protected by barriers to entry. The exchange rate pass-through scenario, however, is not comparable to the nature of compliance cost changes expected under the MP&M regulation and the resultant pass-through responses from domestic producers because the studies focus primarily on the impact of exchange rate changes on prices of imported goods and not on prices of domestically produced goods. Feinberg's study appears to be more relevant, but he does not present pass-through rates for individual industries, and does not explain why pass-through rates are much lower for capital-intensive and concentrated industries and those protected by barriers to entry.

B.A.3 Tax Pass-Through

The literature on tax pass-through examines the impact of excise tax changes on prices. Of the several studies that addressed the issue of tax pass-through, the majority report pass-through rates slightly in excess of a 100 percent (Ashenfelter et al., 1998). This literature is not entirely relevant to the CPT scenario being analyzed for this rule because most of these studies analyze changes in excise tax rates in the cigarette industry. In addition, excise tax changes on final goods do not affect manufacturing costs, and they have a uniform impact on the entire industry. Excise taxes do affect domestic producers, however, by altering final demand and therefore revenues received.

B.A.4 Studies Cited

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ACRONYMS

CAPM: Capital Asset Pricing Model

CPT: cost pass-through

ECI: Employment Cost Index

PPI: Producer Price Index

ROA: risk-normalized return on assets

Appendix C: Summary of Moderate Impact Threshold Values by Sector

INTRODUCTION

Facilities subject to *moderate impacts* from the rule are expected to experience financial stress short of closure. This analysis uses two financial indicators: (1) Pre-Tax Return on Assets (PTRA) and (2) Interest Coverage Ratio (ICR). These threshold values were compared to pre- and post-compliance PTRA and ICR values for sample facilities to determine if facilities choosing to remain in business after promulgation of effluent guidelines would experience moderate impacts on their ability to attract and finance new capital. The remainder of this appendix describes the sources and methodology used to derive sector-specific moderate impact threshold values.

EPA calculated the thresholds using income and financial structure information by 4-digit SIC code from the Risk Management Association (RMA) *Annual Statement Studies* for eight years 1994-2001 (RMA, 2001; RMA 1998). This source provides quartile values derived from statements of commercial bank borrowers and loan applicants for firms having less than \$250 million in total assets. These criteria may introduce bias, since firms with particularly poor financial statements might be less likely to apply to banks for loans, and some types of firms may be more likely to use bank financing than others. However, the RMA data offers the advantage of being available by 4-digit SIC codes and for quartile ranges.

RMA did not provide data for all 4-digit SIC codes associated with an MP&M sector. Out of 174 manufacturing SIC codes and 50 non-manufacturing SIC codes, 52 manufacturing SIC codes (30 percent) and 13 non-manufacturing SIC codes (26 percent), had no years of data available. RMA did not compile data for any SIC codes in two manufacturing sectors, Ordnance and Aerospace and one non-manufacturing sector, Precious Metals and Jewelry. When data were not available for any SIC codes within the sector, EPA calculated an average manufacturing or non-manufacturing threshold to use as a proxy.

The 4-digit SIC code data were consolidated into weighted sector averages, weighted by 1997 value of shipments from the Economic Censuses (U.S. DOC, 1997). For each sector and impact measure, a separate threshold was calculated for manufacturing and non-manufacturing SIC codes. The use of the RMA data for calculating the threshold values for pre-tax return on assets and interest coverage ratio is outlined below.

C.1 DEVELOPING THRESHOLD VALUES FOR PRE-TAX RETURN ON ASSETS (PTRA)

Pre-tax return on total assets measures the effectiveness of management in employing the resources available to it. A low ratio may indicate that a borrower would have difficulty financing treatment investments and continuing to attract investment.

The following data from Risk Management Association *Annual Statement Studies* were used to calculate PTRA:

- ▶ *% Profit Before Taxes / Total Assets_{25th}* Ratio of profit before taxes divided by total assets and multiplied by 100 for the lowest quartile of values in each 4-digit SIC code.
- ▶ *Operating Profit* Gross profit minus operating expenses.
- ▶ *Profit Before Taxes* Operating profit minus all other expenses (net).

RMA provides a measure of pre-tax return on assets that approximates the measure that EPA defined for the moderate impact analysis. As defined by RMA, this measure is the ratio of pre-tax *income* to assets, designated ROA_{RMA} :

$$ROA_{RMA} = \text{Pre-Tax Income (EBT)} / \text{ASSETS}_{25th}$$

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However, as defined by EPA for its analysis, the numerator of the PTR measure requires the use of earnings before interest and taxes (EBIT) instead of pre-tax income (EBT). Defined as EBIT, the PTR numerator will capture all return from assets, whether going to debt or equity. To derive a pre-tax, total return value, EPA adjusted RMA's measure of PTR using the median percentage values of EBIT and EBT available from RMA. This adjustment yields the PTR measure that EPA used in the moderate impact analysis, designated $ROA_{MP\&M}$:

$$ROA_{MP\&M} = ROA_{RMA} * EBIT / EBT$$

Negative values are included in the weighted-sector PTR averages but a different method is used to adjust the ROA values reported in RMA to the value used in the moderate impact analysis. Specifically, using only those observations (i.e., 4-digit SIC code and year combinations) with positive values for % Profit Before Taxes / Total Assets, Operating Profit, and Profit Before Taxes, EPA calculated an adjustment factor by subtracting the difference between $ROA_{MP\&M}$ and ROA_{RMA} as follows:

$$ROA_{MP\&M} - ROA_{RMA} = \text{adjustment factor.}$$

Those values were consolidated into sector-specific adjustment factors, weighted by 1997 value of shipments from the Economic Censuses (U.S. DOC, 1997). Each negative PTR observation from RMA was adjusted by its sector specific adjustment factor to approximate the measure used in the moderate impact analysis:

$$ROA_{RMA} + \text{sector-specific adjustment factor} = ROA_{MP\&M}$$

The sector-specific adjustment factors average 0.47 for manufacturing sectors and range from 0.13 for the Office Machines sector to 0.60 for the Aircraft and Motor Vehicle sectors. The sector-specific adjustment factors average 0.22 for non-manufacturing sectors and range from 0.15 for the Motor Vehicle sector to 0.74 for the Railroad sector.

C.2 DEVELOPING THRESHOLD VALUES FOR INTEREST COVERAGE RATIO (ICR)

Interest coverage ratio is a measure of a firm's ability to meet current interest payments and, on a pro-forma basis, to meet the additional interest payments under a new loan. A high ratio may indicate that a borrower would have little difficulty in meeting the interest obligations of a loan. This ratio also serves as an indicator of a firm's capacity to take on additional debt.

The following data from Risk Management Association *Annual Statement Studies* were used to calculate ICR:

- ▶ $EBIT/Interest_{25th}$ Ratio of earnings (profit) before annual interest expense and taxes (EBIT) divided by annual interest expense for the lowest quartile of values in each 4-digit SIC code.
- ▶ $\% Depr., Dep., Amort./Sales_{med}$ Median ratio of annual depreciation, amortization and depletion expenses divided by net sales and multiplied by 100.
- ▶ *Operating Profit* Gross profit minus operating expenses.

RMA provides a measure of interest coverage that approximates the measure that EPA defined for the moderate impact analysis. As defined by RMA, this measure is the ratio of earnings before interest and taxes to interest, designated ICR_{RMA} :

$$ICR_{RMA} = EBIT / INTEREST_{25th}$$

However, as defined by EPA for its analysis, the numerator of the ICR measure requires the use of earnings before interest, taxes, depreciation, and amortization (EBITDA) instead of earnings before interest and taxes (EBIT). Defined this way, the ICR numerator will include all operating cash flow that could be used for interest payments. To derive the desired ICR value (designated $ICR_{MP\&M}$), EPA adjusted the RMA value as outlined below:

$$ICR_{MP\&M} = EBITDA / INTEREST$$

Therefore, $ICR_{MP\&M} = ICR_{RMA} * (EBIT + DA) / EBIT$
 or $ICR_{MP\&M} = ICR_{RMA} * \{1 + [(DA / SALES) / (EBIT / SALES)]\}$

For consistency of calculation, EPA used the median values available from RMA for the adjusting both the numerator (DA / SALES) and denominator (EBIT / SALES) terms.¹

EPA used the same method as described above to adjust the negative ICR values reported in RMA to the value used in the moderate impact analysis. Including only those observations with positive values for EBIT/Interest, % Depr., Dep., Amort./Sales, and Operating Profit, an adjustment factor was calculated by subtracting the difference between $ICR_{MP\&M}$ and ICR_{RMA} as follows:

$$ICR_{MP\&M} - ICR_{RMA} = \text{adjustment factor.}$$

A sector-specific adjustment factor was calculated for ICR values similar to the PTR. Each negative ICR observation from RMA was adjusted by its sector specific adjustment factor to approximate the measure used in the moderate impact analysis:

$$ICR_{RMA} + \text{sector-specific adjustment factor} = ICR_{MP\&M}$$

The sector-specific adjustment factors average 0.59 for manufacturing sectors and range from 0.28 for the Precious Metals and Jewelry sector to 0.79 for the Printed Circuit Board sector. The sector-specific adjustment factors average 0.50 for non-manufacturing sectors and range from 0.24 for the Office Machines sector to 1.85 for the Aircraft sector.

¹ Numerator (% Depr., Dep., Amort./Sales) is available for quartile values; denominator (Operating Profit) only for median values.

C.3 SUMMARY OF RESULTS

Table C.1 shows the resulting threshold values for PTRA and ICR by sector. The PTRA values for manufacturers range from zero percent for the Office Machine sector to 2.8 percent for the Aircraft and Household Equipment sectors and for the non-manufacturers the values range from 0.3 percent for the Office Machine sector to 3.1 percent for the Railroad sector. The ICR values for manufacturers range from 1.4 for the Office Machine and Railroad sectors to 2.3 for the Hardware, Household Equipment, and Printed Circuit Board sectors and for the non-manufacturers the values range from 1.2 for the Office Machine sector to 2.9 for the Aircraft sector.

In assessing moderate impacts, EPA used the non-manufacturing threshold for facilities that reported 100 percent of their revenues came from rebuilding and maintenance; otherwise, EPA used the manufacturing threshold.

Table C.1: Summary of Moderate Impact Thresholds by Sector

Sector	Pre-Tax Return on Assets (PTRA)		Interest Coverage Ratio (ICR)	
	Manufacturing	Non-Manufacturing	Manufacturing	Non-Manufacturing
Hardware ^b	2.6%	1.6%	2.3	1.9
Aircraft	2.8%	0.4%	2.2	2.9
Electronic Equipment ^b	2.1%	1.6%	2.2	1.9
Stationary Industrial Equipment	2.1%	2.5%	2.1	2.8
Ordnance ^a	2.2%	1.6%	2.1	1.9
Aerospace ^a	2.2%	1.6%	2.1	1.9
Mobile Industrial ^b	2.6%	1.6%	2.1	1.9
Instrument	2.2%	2.0%	2.1	2.0
Precious and Non-Precious ^a	1.8%	1.6%	1.7	1.9
Ships and Boats	1.7%	1.0%	1.6	2.0
Household Equipment	2.8%	2.6%	2.3	2.0
Railroad ^b	1.1%	3.1%	1.4	2.7
Motor Vehicle	2.4%	1.5%	2.0	1.7
Bus and Truck	2.3%	1.7%	2.0	2.8
Office Machine	0.0%	0.3%	1.4	1.2
Printed Circuit Board ^b	2.5%	1.6%	2.3	1.9
Job Shop ^b	2.3%	1.6%	2.2	1.9
Other Metal Products	1.0%	1.7%	1.6	1.8
Iron and Steel	2.4%	N/A	2.2	N/A
Unknown Sector ^a	2.2%	1.6%	2.1	1.9

^a When data were not available for any SIC codes within the sector, EPA calculated an average manufacturing or non-manufacturing threshold to use as a proxy.

^b There are no non-manufacturing SIC codes in several sectors, but in these sectors there are some facilities who reported that all of their revenue came from rebuilding and maintenance. In these cases, EPA used the average non-manufacturing thresholds in that sector as a proxy for the non-manufacturing threshold.

Source: RMA, 2001; RMA, 1998; U.S. Economics Census, 1997; U.S. EPA Analysis, 2002.

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Appendix D: Estimating Capital Outlays for MP&M Discounted Cash Flow Analyses

INTRODUCTION

The economic impact analysis for the Metal Products & Machinery Industry (MP&M) final regulation involved calculation of the business value of sample facilities on the basis of a discounted cash flow (DCF) analysis of operating cash flow as reported in facility questionnaires. Business value is calculated on a pre- and post-compliance basis and the change in this value serves as an important factor in estimating regulatory impacts in terms of potential facility closures. For proposal, the business value calculation was based only on cash flow from operations and did not recognize cash outlays for capital acquisition as a component of cash flow. EPA Office of Water (OW) previously identified that the omission of capital acquisition cash outlays from the DCF analysis may lead to overstatement of the business value of sample facilities and, as a consequence, understatement of regulatory impacts in terms of estimated facility closures.

In response to this omission, the Office of Management and Budget suggested the adoption of depreciation as a surrogate for cash outlays for capital replacement and additions. However, for several reasons EPA believes depreciation is a poor surrogate. First, depreciation is meant to capture the consumption/use of previously acquired assets, *not* the cost of replacing, or adding to, the existing capital base. Therefore, depreciation is fundamentally the wrong concept to use as a surrogate for capital outlays for capital replacement and additions. Second, depreciation is estimated based on the historical asset cost, which may understate or overstate the real replacement cost of assets. Third, both book and tax depreciation schedules generally understate the assets' useful life. Thus, reported depreciation will overstate real depreciation value for recently acquired assets that are still in the depreciable asset base, and conversely, understate the real depreciation value of assets that have expired from the depreciable asset base but still remain in valuable use. Finally, depreciation does not capture the important variations in capital outlays that result from differences in revenue growth and financial performance among firms. Businesses with real growth in revenues will need to expand both their fixed and working capital assets to support business growth, and all else being equal, growing businesses will have higher ongoing outlays for fixed and working capital assets. Similarly, the ability of businesses to renew and expand their asset base depends on the financial productivity of the deployed capital as indicated by measures such as return on assets or return on invested capital. As a result, businesses with "strong" asset productivity will attract capital for renewal and expansion of their asset base, while businesses with "weak" asset productivity will have difficulty attracting the capital for renewal and expansion of the business' asset base. All else being equal, businesses with strong asset productivity will have higher ongoing outlays for capital assets; businesses with weak asset productivity will have lower ongoing outlays for capital assets.

As an approach to addressing the omission of capital acquisition cash outlays from the DCF analysis, EPA undertook to estimate a regression model of capital outlays using capital expenditure and relevant explanatory financial and business environment information for public-reporting firms in the MP&M industry sectors. The estimated model was then used to estimate capital outlays for facilities in the MP&M sample dataset. The estimated capital outlay values were used in the DCF analyses to calculate business value of sample facilities and estimate regulatory impacts in terms of facility closures.

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This appendix reports the results of this effort, including: an overview of the analytic concepts underlying the analysis of capital outlays; specific variables included in the regression analysis; summary of data selection and preparation; general specification of regression models to be tested; and the findings from the regression analyses.

D.1 ANALYTIC CONCEPTS UNDERLYING ANALYSIS OF CAPITAL OUTLAYS

On the basis of general economic and financial concepts of investment behavior, EPA began its analysis by outlining a framework relating the level of a firm's capital outlays to explanatory factors that:

- ▶ can be observed for public-reporting firms either as firm-specific information or general business environment information and thus be included in a regression analysis; and
- ▶ for firm-specific information, are also available from the MP&M sample facility dataset.

To aid in identifying the explanatory concepts and variables that might be used in the analysis and as well in specifying the models for analysis, EPA reviewed recent studies of the determinants of capital outlays. EPA's review of this literature generally confirmed the overall approach in seeking to estimate capital outlays and helped to identify additional specific variables that other analysts found to contribute important information in the analysis of capital outlays (e.g., the decision to test capacity utilization as an explanatory variable, see below, resulted from the literature review). Articles reviewed are listed in Attachment D.A to this appendix.

Table D.1 beginning below and continuing the following two pages summarizes the conceptual relationships between a firm's capital outlays and explanatory factors that EPA sought to capture in this analysis. In the table, EPA outlines the concept of influence on capital outlays, the general explanatory variable(s) that EPA identified to capture the concept in a regression analysis, and the hypothesized mathematical relationship (sign of estimated coefficients) between the concept and capital outlays. Table D.2 identifies the specific variables included in the analysis, including any needed manipulations and the correspondence of the variables to MP&M survey information.

Table D.1: Summary of Factors Influencing Capital Outlays

Explanatory Factor/Concept To Be Captured in Analysis	Translation of Concept to Explanatory Variable(s)	Expected Relationship
<i>Availability of attractive opportunities for additional capital investment.</i> A firm's owners, or management acting on behalf of owners, should expend cash for capital outlays only to the extent that the expected return on the capital outlays—whether for replacement of, or additions to, existing capital stock—are sufficient to compensate providers of capital for the expected return on alternative, competing investment opportunities, taking into account the risk of investment opportunities.	Historical <i>Return On Assets</i> of establishment as a indicator of investment opportunities and management effectiveness, and, hence, of desirability to expand capital stock and ability to attract capital investment. Use of a historical variable implicitly assumes past performance is indicative of future expectations.	Positive
<i>Business growth and outlook as a determinant of need for capital expansion and attractiveness of investment opportunities.</i> All else equal, a firm is more likely to have attractive investment opportunities and need to expand its capital base if the business is growing and the outlook for business performance is favorable.	<i>Revenue Growth</i> , from the prior time period(s) to the present, provides a <i>historical</i> measure of business growth and is a potential indicator of need for capital expansion. Use of a historical variable implicitly assumes past performance is indicative of future expectations.	Positive
	Clearly, the theoretical preference is for a forward-looking indicator of business growth and need for capital expansion. Options EPA identified include <i>Index of Leading Indicators</i> and current <i>Capacity Utilization</i> , by industry. Higher current <i>Capacity Utilization</i> may presage need for capital expansion.	Positive

Table D.1: Summary of Factors Influencing Capital Outlays

Explanatory Factor/Concept To Be Captured in Analysis	Translation of Concept to Explanatory Variable(s)	Expected Relationship
Importance in capital in business production. All else equal, the more capital intensive the production activities of a business, the greater will be the need for capital outlay to replenish, and add to, the existing capital stock. More capital intensive businesses will spend more in capital outlays to sustain a given level of revenue over time.	<p>The Capital Intensity of production as measured by the production capital required to produce a dollar of revenue provides an indicator of the level of capital outlay needed to sustain and grow production.</p> <p>As an alternative to a firm-specific concept such as Capital Intensity of production, differences in business characteristics might be captured by an Industry Classification variable.</p>	Positive
Life of capital equipment in the business. All else equal, the shorter the useful life of the capital equipment in a business, the greater will be the need for capital outlay to replenish, and add to, the existing capital stock.	<p>No information is available on the actual useful life of capital equipment by business or industry classification. However, the Capital Turnover Rate, as calculated by the ratio of book depreciation to net capital assets, provides an indicator of the rate at which capital is depleted, according to book accounting principles: the higher the turnover rate, the shorter the life of the capital equipment. However, the measure is imperfect for reasons of both the inaccuracies of book reporting as a measure of useful life, and as well the confounding effects of growth in the asset base due to business expansion which will tend to lower the indicated turnover rate, all else equal, without a real reduction in life of capital equipment.</p> <p>As above, an alternative to a firm-specific concept, differences in business characteristics might be captured by an Industry Classification variable.</p>	Positive, generally, but with recognition of the potential for counter-trend effects
The cost of financial capital. The cost at which capital both debt and equity is made available to a firm will determine which investment opportunities can be expected to generate sufficient return to warrant use of the financial capital for equipment purchases. All else equal, the higher the cost of financial capital, the fewer the investment/capital outlay opportunities that would be expected to be profitable and the lower the level of outlays for replacement of, or additions to, capital stock.	<p>Preferably, measures of cost-of-capital would be developed separately for debt and equity.</p> <p>The Cost of Debt Capital, as measured by an appropriate benchmark interest rate, provides an indication of the terms of debt availability and how those terms are changing over time. Preferably, the debt cost/terms would reflect the credit condition of the firm, which could be based on a credit safety rating (e.g., S&P Debt Rating). While such information would be available for public firms, EPA judged that developing a comparable concept for MP&M sample facilities would not be possible within the scope of this analysis.</p>	Negative
	<p>The cost of equity capital is more problematic than the cost of debt capital since it is not directly observable for either public-reporting firms or, in particular, private firms in the MP&M dataset. However, a readily available surrogate such as Market-to-Book Ratio provides insight into the terms at which capital markets are providing equity capital to <i>public-reporting firms</i>: the higher the Market-to-Book Ratio, the more favorable the terms of equity availability. Although such information would <i>not</i> be available for private firms in the MP&M sample, EPA judged that it would be possible to develop a industry-level value for use with the MP&M facility analysis.</p>	Negative

Table D.1: Summary of Factors Influencing Capital Outlays

Explanatory Factor/Concept To Be Captured in Analysis	Translation of Concept to Explanatory Variable(s)	Expected Relationship
<p>The price of capital equipment. The price of capital equipment in particular, how capital equipment prices are changing over time will influence the expected return from capital outlays. All else equal, when capital equipment prices are increasing, the expected return from incremental capital outlays will decline and vice versa. However, although the generally expected effect of higher capital equipment prices is to remove certain investment opportunities from consideration, the potential effect on <i>total capital outlay</i> may be mixed. If expected returns are such that the demand to invest in capital projects is relatively inelastic, the effect of higher prices for capital equipment may be to raise, instead of lower, the total capital outlay for a firm.</p>	Index provides an indicator of the change in capital equipment prices.	Negative, generally, but with recognition of the potential for counter-trend effects

Source: U.S. EPA analysis.

D.2 SPECIFYING VARIABLES FOR THE ANALYSIS

Working from the general concepts of explanatory variables outlined above, EPA defined the specific explanatory variables to be included in the analysis. A key requirement of the regression analysis is that the firm-specific explanatory variables included in the regression analysis later be able to be used as the basis for estimating capital expenditures for facilities in the MP&M dataset. As a result, in defining the firm-specific variables, it was necessary to ensure that the definition of variables selected for the regression analysis using data on public-reporting firms be consistent with the data items available for facilities in the MP&M dataset.

Also, EPA's selection of firm-specific variables was further constrained by an earlier decision to use the Value Line Investment Survey (VL) as the source of firm-specific information for the regression analysis. The decision to use VL as the source of firm-specific data for the analysis was driven by several considerations:

- ▶ *Considerably lower price than alternatives.* VL data were available at a price of \$95 for a one-time data purchase; the price for other data sources such as Bloomberg and Standard & Poor's ranged from \$7,000 to \$11,000.
- ▶ *Reasonable breadth of public-reporting firm coverage.* The VL dataset includes 7,500 firms.
- ▶ *Reasonable breadth of temporal coverage.* VL provides data for the most recent 10 years i.e., 1991-2000. Although ideally EPA would have preferred a longer time series to include more years not in the "boom" investment period of the mid- to late-1990s.
- ▶ *Timeliness of access.* The VL data are provided as a standard package and thus could be available within a week of ordering while other data sources (e.g., Bloomberg) would have required more time because data would have provided as a custom purchase.
- ▶ *Reasonable coverage of concepts/data needed for analysis.* The VL data includes a wide range of financial data that are applicable to the analysis (VL provides 37 data items over the 10 reporting years; see Attachment DB). However, because of the pre-packaged nature of the VL data, it was not possible to customize any data items to support more precise definition of variables in the analysis. In particular, EPA found that certain balance sheet items were not reported to the level of specificity preferred for the analysis. Overall, though, EPA expects the consequence of using more aggregate, less-refined concepts should be minor.

The decision to use VL data for the analysis constrained, in some instances, EPA's choice of variables for the analysis.

Table D.2 reports the specific definitions of variables included in the analysis (both the dependent variable and explanatory variables), including any needed manipulations, the data source, the MP&M estimation analysis equivalent (either the corresponding variable(s) in the MP&M questionnaire or other source outside the questionnaire), and any issues in variable definition.

Table D.2: Variables For Capital Expenditure Modeling Analysis				
Variables for Regression Analysis			MP&M Analysis Equivalent	Comment / Issue
Variable	Source	Calculation		
Dependent Variable				
Gross expenditures on fixed assets: CAPEX, includes outlays to replace, and add to, existing capital stock	Value Line	Obtained from VL as Capital Spending per Share. CAPEX calculated by multiplying by Average Shares Outstanding.	None: to be estimated based on estimated coefficients.	This value and all other dollar values in the regression analysis were deflated to 1996 (base year for MP&M regulatory analysis) using 2-digit SIC PPI values.
Explanatory Variables				
Firm-Specific Variables				
On Assets: ROA	Value Line	ROA = Operating Income / Total Assets. Both Operating Income, defined as Revenue less Operating Expenses (CoGS+SG&A), and Total Assets were obtained directly from VL.	From Survey: Revenue less Total Operating Expenses (Material & Product Costs + Production Labor + Cost of Contract Work + Fixed Overhead + R&D + Other Costs & Expenses)	Would have preferred a post-tax concept in numerator and a deployed production capital concept in denominator. However, VL provides no tax value per se and would require calculation of tax using an estimated tax rate, which could introduce error. Also neither VL nor MP&M survey data provide sufficient information to get at deployed production capital.

Table D.2: Variables For Capital Expenditure Modeling Analysis

Table D.2: Variables For Capital Expenditure Modeling Analysis				
Variables for Regression Analysis			MP&M Analysis Equivalent	Comment / Issue
Variable	Source	Calculation		
Revenue Growth: RVGR	Value Line	<p>Primary formulation tested for <i>linear</i> models was percentage change in revenue over two years prior to current year: $RVGR = (REV_t - REV_{t-2}) / REV_{t-2}$. VL provides 10 years of financial statement values 1991-2000, including Revenue by year.</p> <p>For <i>log-linear</i> models, the growth concept was dropped and REV was used as the explanatory variable (see below and also see later discussion under model specification).</p>	No equivalent needed. Analysis proposed to set this value to zero in estimating capital outlay values for MP&M facilities. The use of a zero growth value is consistent with estimating the replacement capital expenditures in a no-growth steady-state.	<p>Using a revenue growth term in the analysis defined over the prior two years requires three years of revenue data (e.g., current year plus trailing two years) and effectively eliminates two observation years from the analysis (1991 and 1992). Given that these data years occurred at the end of a recession period and before the mid- to late-90s economic boom period, EPA was very concerned about the potential loss of these years from the analysis dataset.</p> <p>In the end, the use of a log-linear model eliminated the need to construct the lagged difference variables and thus mooted the concern over loss of early year observations. The use of the log-linear model, however, also eliminated the potential to set the growth term to zero in estimating baseline capital outlays for MP&M facilities.</p>
Revenue: REV	Value Line	In the linear models, REV included as a scale variable together with RVGR , as outlined above. For log-linear models, retained only REV as the explanatory variable. The simple variable, REV , captures the percent change/growth concept in the log-linear formulation.	From Survey: Revenue	Using REV only and not RVGR in the log-linear model restored the two data years at the beginning of the analysis period (1991 and 1992) to the analysis dataset. EPA believes including data for the first two observation period years is important for the generality of the analysis. Also tested Total Assets as a scale variable, which provided good, but not as strong, an explanation, as REV .
Capital Turnover Rate: CAPT	Value Line	$CAPT = \text{Depreciation} / \text{Total Assets}$. Depreciation and Total Assets directly available from VL.	From Survey: Depreciation / Total Assets	Would have preferred denominator of <i>net fixed assets</i> instead of <i>total assets</i> . However, VL provides detailed balance sheet information for only the four most recent years. Not possible to separate current assets and intangibles from total assets.
Capital Intensity: CAPI	Value Line	$CAPI = \text{Total Assets} / \text{Revenue}$. Total Assets and Revenue directly available from VL	From Survey: Total Assets / Revenue	As above, would have preferred <i>net fixed assets</i> instead of <i>total assets</i> , but needed data are not available from VL for the full analysis period.
Market-to-Book Ratio: MV/B	Value Line	MV/B = average market price of common equity (Price) divided by book value of common equity (Book Value per Share). Price and Book Value per Share directly available from VL.	Use average of MV/B for firms by MP&M industry group in regression analysis dataset; calculated at time of MP&M industry survey.	Ultimately found MV/B highly correlated with other, more important explanatory variables, which makes sense, given that equity terms would be derived from more fundamental factors, such as ROA . Omitting MV/B from the analysis eliminated the need to define an approach to use this variable with MP&M survey data.

Table D.2: Variables For Capital Expenditure Modeling Analysis

Variables for Regression Analysis			MP&M Analysis Equivalent	Comment / Issue
Variable	Source	Calculation		
General Business Environment Variables				
Interest on 10-year, A-rated industrial debt: DEBTCST	Bloomberg Financial Services	DEBTCST = annual average of rates for each data year	Use average of DEBTCST rates at time of MP&M industry survey.	10-year maturity, industry debt selected as reasonable benchmark for industry debt costs. 10 years became “standard” maturity for industrial debt during 1990s.
Index of Leading Indicators: ILI	Conference Board	Monthly index series available from Conference Board. For linear models, ILI = percent change from beginning to end of current year. For log-linear models, ILI = geometric mean of current year values.	For linear formulation, use average of year-to-year percent change in ILI at time of MP&M industry survey. For log-linear formulation, use average of ILI values at time of MP&M industry survey.	
Capacity Utilization by Industry: CAPUTIL	Federal Reserve Board (Dallas Federal Reserve)	Monthly index series available from Federal Reserve. For linear models, CAPUTIL = percent change in annual average values from prior year to current year. For log-linear models, CAPUTIL = current year average value.	For linear formulation, use average of year-to-year percent change in CAPUTIL at time of MP&M industry survey. For log-linear formulation, use average of CAPUTIL values at time of MP&M industry survey.	
Producer Price Index series for capital equipment: CAPPRC	Bureau of Labor Statistics	Annual average values available from BLS. For linear models, CAPPRC = percent change from prior year to current year. For log-linear models, CAPPRC = current year average value as reported by BLS.	For linear formulation, use average of year-to-year percent change in CAPPRC at time of MP&M industry survey. For log-linear formulation, use average of CAPPRC values at time of MP&M industry survey.	BLS reports PPI series for capital equipment based on “consumption bundles” defined for manufacturing and non-manufacturing industries. For this analysis, EPA used the PPI series based on the manufacturing industry bundle.

Source: U.S. EPA analysis.

D.3 SELECTING THE REGRESSION ANALYSIS DATASET

In addition to specifying the variables to be used in the regression analysis, EPA also needed to select the public firm dataset on which the analysis would be performed.

As noted above, EPA used the Value Line Investment Survey as the source for public firm data. VL includes over 7,500 publicly traded firms and identifies firms’ principal business both by a broad industry classification (e.g., Electrical Equipment, Machinery) and by an SIC code assignment. In most instances, the SIC codes assignment is only at the 2-digit level. To build the public firm dataset corresponding to the MP&M industry sectors, EPA initially selected all firms included in the following 2-digit SIC code families:

- ▶ 2500: Furniture and fixtures,
- ▶ 3300: Primary metal industries,
- ▶ 3400: Fabricated metal products,
- ▶ 3500: Industrial machinery and equipment,
- ▶ 3600: Electrical and electronic equipment,
- ▶ 3700: Transportation equipment, and
- ▶ 3800: Instruments and related products.

From manual inspection, EPA deleted firms in four-digit SIC code 3579, which, in the VL classification, was comprised only of software manufacturers. In addition, in SIC code group 3300, EPA included firms only in the ferrous metal processing sectors: SIC codes 3311, 3312, 3315, 3316, 3317, and 3398.¹

As a result of this selection, EPA developed an initial dataset of 1,015 firms. On inspection, EPA found that a substantial number of firms did not have data for the full 10 years of the analysis period. The general reason for the omission of some years of data is that the firms did not become publicly listed in their current operating structure—whether through an initial public offering, spin-off, divestiture of business assets, or other significant corporate restructuring that renders earlier year data inconsistent with more recent data—until after the beginning of the 10-year data period.² As a result, the omission of observation years for a firm always starts at the beginning of the data analysis period. This systematic front-end truncation of firm observations in the dataset could be expected to bias the analysis in favor of the capital expenditure behavior nearer the end of the 1990s decade. To avoid this problem, EPA removed all firm observations that have fewer than 10 years of data. As a result, the dataset used in the analysis has a total of 3,900 yearly data observations and represents 390 firms.

Table D.3 presents the number of firms by industry classifications.

Table D.3: Number of Firms by Industry Classifications	
SIC Industry Classification	Number of Firms
2500: Furniture and fixtures	13
3300: Primary metal industries	27
3400: Fabricated metal products	24
3500: Industrial machinery and equipment	119
3600: Electrical and electronic equipment	101
3700: Transportation equipment	65
3800: Instruments and related products	41

D.4 SPECIFICATION OF MODELS TO BE TESTED

On the basis of the variables listed above and their hypothesized relationship to capital outlays, EPA specified a time-series, cross sectional model to be tested in the regression analysis. EPA's dataset consisted of 390 cross sections observed at 10 years (1991 through 2000). The general structure of this model was as follows:

$$\text{CAPEX}_{i,t} = f(\text{ROA}_{i,t}, \text{REV}_{i,t}, \text{CAPT}_{i,t}, \text{CAPI}_{i,t}, \text{DEBTCST}_{i,t}, \text{CAPPRC}_t, \text{CAPUTIL}_{j,t})$$

¹ These 4-digit SIC codes include all MP&M sectors in SIC 2-digit code 33 *plus* 4-digit SIC code 3311, to capture information for the steel manufacturing industry.

² When VL adds a firm to its dataset, it fills in the public-reported data history for the firm for the lesser of 10 years or the length of time that the firm has been publicly listed and thus subject to SEC public reporting requirements.

Where:

$CAPEX_{i,t}$	=	capital expenditures of firm i , in time period t ; ¹
t	=	year (year = 1991, . . . , 2000);
i	=	firm i ($i=1, . . . , 390$);
j	=	industry classification j
$ROA_{i,t}$	=	return on total assets for firm i in year t ;
$REV_{i,t}$	=	revenue (\$ millions) for firm i in year t ;
$CAPT_{i,t}$	=	capital turnover rate for firm i in year t ;
$CAP_{i,t}$	=	capital intensity for firm i in year t ;
$DEBTCST_t$	=	financial cost of capital in year t ;
$CAPPRC_t$	=	price of capital goods in year t ;
$CAPUTIL_{j,t}$	=	the Federal Reserve Board's Index of Capacity utilization for a given industry j in year t .

EPA tested both linear and log-linear model specifications. Both models fit quit well, achieving overall correlation (R^2) in the upper 80 percent/low 90 percent range. However, the pattern of coefficient significance was better in the log-linear model. In addition, the log-linear model offered advantages in terms of retention of early time period observations and variable specification, as discussed below. Therefore, EPA selected a log-linear specification as the final model. The following paragraphs briefly discuss testing of both linear and log-linear forms of the model. Parameter estimates are presented for the final log-linear model only because this specification appeared to be superior to a linear model.

D.4.1 Linear Model Specification

EPA first tested linear models of CAPEX as a function of the proposed explanatory variables. In testing linear models of CAPEX, EPA tested a number of structural modifications within the overall hypothesized framework of explanatory variables. These included:

- ▶ Testing the influence of industry classification on the estimation of the coefficients for certain of the explanatory variables: e.g., using the product of an industry classification dummy variable and CAPPRC to test whether certain industries—in particular, “high-tech” vs. “traditional” industries—responded differently to change in price of capital equipment over time.
- ▶ Testing contemporary vs. lagged specification of certain explanatory variables: e.g., using prior, instead of current, period revenue, REV, as an explanatory variable.
- ▶ Testing scale-normalized specification of the dependent variable: e.g., using CAPEX/REV as the dependent variable instead of simple CAPEX.
- ▶ Testing flexible functional forms that included quadratic terms.
- ▶ Testing additional explanatory variables including the index of 10 leading economic indicators (ILI) and market-to-book ratio (MV/B).

EPA also tested the data for autocorrelation, heteroscedasticity, and multicollinearity.

Cross-sectional, time-series datasets typically exhibit both autocorrelation and group-wise heteroscedasticity characteristics. Autocorrelation is frequently present in economic time series data as the data display a “memory” with the variation not being independent from one period to the next. Heteroscedasticity usually occurs in cross-sectional data where the scale of the dependent variable and the explanatory power of the model vary across observations. Not surprisingly, the dataset used in this analysis had both characteristics.

The collinearity diagnostic showed that several independent variables are collinear. In particular, EPA found that the index of leading economic indicators (ILI) and the price of capital equipment (CAPPRC) variables are highly correlated. EPA further found that the market-to-book ratio variable (MV/B) was highly correlated with both capital turnover (CAPT) and return-on-assets (ROA) variables. To address the multicollinearity issue, EPA substituted capacity utilization (CAPUTIL) for the index of leading economic indicators (ILI) and dropped the market-to-book ratio (MV/B) variable in the final model.

¹ All dollar values were deflated to 1996 (base year for MP&M regulatory analysis) using 2-digit SIC PPI values.

D.4.2 Log-Linear Model Specification

The main advantage of the log-linear model is that it incorporates directly the concept of percent change in the explanatory variables. Specifying the key regression variables as logarithms permitted us to estimate directly as the coefficients of the model, the elasticities of capital expenditures with respect to firm financial characteristics and general business environment factors. In addition, by eliminating the need to use percent change variables, EPA was able to avoid losing early year observations in the analysis dataset. Finally, the logarithmic transformations helped to reduce outlier effects in the model.

EPA specified a log-linear model, as follows:

$$\ln(\text{CAPEX}_{i,t}) = \alpha + \Sigma[\beta_x \ln(X_{i,t})] + \Sigma[\gamma_y \ln(Y_t)] + \epsilon$$

Where:

$\text{CAPEX}_{i,t}$	=	capital expenditures of firm i , year t ;
β_x	=	elasticity of capital expenditures with respect to firm characteristic X ;
$X_{i,t}$	=	a vector of financial characteristics of firm i , year t ;
γ_y	=	elasticity of capital expenditures with respect to economic indicator Y ;
Y_t	=	a vector of economic indicators, year t ; for CAPUTIL, Y is also differentiated by industry classification
ϵ	=	an error term; and
$\ln(x)$	=	natural log of x

Based on this model, the elasticity of capital expenditures with respect to an explanatory variable, for example, return on assets is calculated as follows:

$$E(\text{CAPEX}) = \frac{d \ln(\text{CAPEX})}{d \ln(\text{ROA})} = \frac{d(\text{CAPEX})/\text{CAPEX}}{d(\text{ROA})/\text{ROA}}$$

Because the log-linear specification incorporates directly the concept of percent change in the explanatory variables, EPA dropped the “change” specification variables i.e., revenue growth (REVGR), year-to-year change in the Index of Leading Indicators (ILIGR), and year-to-year change in the Capital Equipment Price Index (CAPPRC) from the analysis. For these variables, EPA used the logarithm of the simple, unadjusted values in the log-linear specification.

One disadvantage of the specified log-linear model is that the logarithmic transformation is not feasible for negative and zero values. This means that negative and zero values require linear transformation to be included in the analysis. The following variables in the sample required transformation:

- ▶ CAPEX: four firms in the sample reported zero capital expenditures at least in one time period. EPA set these expenditures to \$1.
- ▶ REVENUE: one firm reported negative revenue (-\$1,018) in one time period. Because this is likely due to accounting adjustments from prior period reporting, EPA set the firm’s revenue in the current time period to \$1.
- ▶ ROA: the values for return on assets in the public firm sample range from -1.1 to 0.6. Approximately 25 percent of the firms in the dataset reported negative ROAs in at least one year. To address this issue while reducing potential effects of data transformation on the modeling results, EPA used the following data transformation approach:
 - EPA excluded 12 firms with *any* annual ROA values below the 99th percentile of the ROA distribution (i.e., $\text{ROA} \leq -0.31$).
 - EPA used an additive data transformation to ensure that remaining negative ROA values were positive in the logarithm transformation. The additive transformation was performed by adding 0.31 to all ROA values.

The analysis tested several specifications of a log-linear model, including models with slope dummies for different industrial sectors and models with the intercept suppressed. The model presented below was most successful at explaining firms' investment behavior.

EPA estimated the specified model using the generalized least squares procedure. This procedure involves the following two steps:

- ▶ First, EPA estimated the model using simple OLS, ignoring autocorrelation for the purpose of obtaining a consistent estimator of the autocorrelation coefficient (ρ);
- ▶ Second, EPA used the generalized least squares procedure, where the analysis is applied to transformed data. The resulting autocorrelation adjustment is as follows:

$$Z_{it} = Z_{it} - \rho Z_{it-1}$$

where Z_{it} is either dependent or independent variables.

EPA was unable to correct the estimated model for group-wise heteroscedasticity due to computational difficulties. The statistical software used in the analysis (LIMDEP) failed to correct the covariance matrix due to the very large number of groups (i.e., 390 firms) included in the dataset. Application of other techniques to correct for group-wise heteroscedasticity was not feasible due to time constraints. The estimated coefficients remain unbiased; however, they are not minimum variance estimators.

Table D.4 presents model results. The model has a fairly good fit, with adjusted R^2 of 0.89. All coefficients have the expected sign and all but two (constant and capital price) are significantly different from zero at the 95th percentile.

Table D.4: Time Series, Cross-Sectional Model Results		
Variable	Coefficient	t-Statistics
Constant	-2.077	-0.97
Ln(ROA)	0.618	9.353
Ln(REV)	1.025	113.867
Ln(CAPT)	0.6	20.285
Ln(CAPI)	0.976	27.342
Ln(DEBTCST)	-0.205	-2.653
Ln(CAPPRC)	-0.478	-0.939
Ln(CAPUTIL)	0.904	3.176
Autocorrelation Coefficient		
r	0.413	27.842

The empirical results show that the output variable (REV) is a dominant determinant of firms' investment spending. A positive coefficient on this variable means that larger firms invest more, all else equal, which is clearly a simple expected result. Very important for the MP&M analysis, as expected, firms with higher financial performance and better investment opportunities (ROA) invest more, all else equal: for each one percent increase in ROA, a firm is expected to increase its capital outlays by 0.62 percent. Other firm-specific characteristics were also found important and will aid in differentiating the expected capital outlay for MP&M facilities according to firm-specific characteristics. Firms that require more capital to produce a given level of business activity (i.e., firms that have high capital intensity, CAPI) tend to invest more: a one percent increase in capital intensity leads to a 0.98 increase in capital spending. Higher capital turnover/shorter capital life (CAPT) also has a positive effect on investment decisions: a one percent increase in capital turnover rate translates to a 0.60 percent in capital outlays.

The model also shows that current business environment conditions play an important role in firms' decision to invest. The

most influential factor is capacity utilization in manufacturing facilities. A one percent increase in the Federal Reserve Index of Capacity Utilization for the relevant industrial sector (CAPUTIL) leads to a 0.90 percent increase in capital investment. Negative signs on the debt cost (DEBTCST) and capital price (CAPPRC) variables match expectations, indicating that less costly credit and falling (either relatively or absolutely) capital equipment prices are likely to have a positive effect on firms' capital expenditures. That these systematic variables are significant in the regression analysis means that EPA will be able to control for economy- and industry-wide conditions in estimating capital outlays for MP&M facilities.

D.4.3 Sensitivity Analysis

To examine the degree to which the estimated model was affected by transformation of ROA values and inclusion/exclusion of firms with the lowest ROA values, EPA ran two additional models. First, EPA estimated a model based on a subset of data that includes only firms with positive ROA values. Second, EPA estimated a model based on a complete dataset that includes the 12 firms with the lowest ROA values. Although all three models produced compatible results, the first model shows some notable differences in the estimated coefficients compared to the model presented in the preceding section. EPA found that when firms with the lowest negative ROAs are excluded from the analysis:

- ▶ The magnitude of the ROA effect on capital expenditures decreases;
- ▶ The magnitude of the debt cost effect on capital expenditures decreases slightly;
- ▶ The coefficient on the capital price term becomes significant.

These differences can be expected since firms with negative ROAs are weak performers and therefore are less likely to have large capital outlays. Not surprisingly, general economic indicators that affect firms' decisions to invest can be less or more important if a firm's financial performance/asset productivity is weak. For financially weaker firms, the financial cost of capital is a more important factor compared to firms that are strong financially. This finding indicates a strong "threshold of adequate financial performance" effect: capital outlays fall off severely at the lowest financial performance levels but the marginal effect of financial performance becomes more moderate as asset productivity moves into a more acceptable i.e., positive return range. Price of capital goods appears to be an insignificant factor in firms' decision to invest when weak firms are included in the analysis. At first, this finding seems to be counterintuitive: previous studies of investment behavior found a strong capital price effect on firms' decision to invest in high tech equipment. However, because financially weak firms are less likely to invest in general, it is reasonable to assume that they will not respond as strongly to changes in capital equipment prices. Thus, their investment decisions were relatively less affected by falling high-tech equipment prices in the last decade.

D.5 MODEL VALIDATION

To validate the results of the regression analysis, EPA used the estimated regression equation to calculate capital expenditures and then compared the resulting estimate of capital expenditures with actual data. EPA used two methods to validate its results:

- ▶ EPA used median values for explanatory variable from the Value Line data as input to estimate capital expenditures and then compared the estimated value to the median reported capital expenditures, and
- ▶ EPA used MP&M survey data to estimate capital expenditures and then compared the estimated values to depreciation reported in the survey.

First, EPA estimated capital expenditures for a hypothetical firm based on the median values of the four dependent variables from the Value Line data and the relevant values of the three economic indicators. The estimated capital expenditures for this hypothetical firm are \$10.9 million. EPA then compared this estimate to the median value of capital expenditures from the Value Line data. The median capital expenditure value in the dataset is \$11.3 million, which provides a very close match to the estimated value. This is not surprising since the same dataset was used to estimate the regression model and to calculate the median values used in this analysis.

EPA also used MP&M survey data to confirm that the estimated capital expenditures seem reasonable. Because the MP&M survey does not provide information on capital expenditures, EPA compared the capital expenditure estimates to the

depreciation values reported in the survey. Depreciation had been proposed as a possible surrogate for cash outlays for capital replacements and additions. However, depreciation does not capture important variations in capital outlays that result from differences in firms' financial performance.

For this analysis, EPA chose a representative facility from each of the nineteen MP&M sectors for model validation. The selected facility for each sector corresponds as closely as possible to the hypothetical median facility in the sector based on the distribution of facility revenues and facility return on assets. For each of the nineteen facilities, EPA estimated capital expenditures using the estimated regression equation and facility financial data. Table D.5 shows the estimated regression coefficients, financial averages for the nineteen MP&M sectors, estimated facility capital expenditures, reported facility depreciation, and the comparison of capital expenditures and depreciation.

As shown in Table D.5, the estimated model provides reasonable estimates of capital expenditures. A facility's size, as indicated by revenue, is a principal determinant of the general range of value for capital expenditures, all else equal (i.e., greater revenues correspond to greater predicted capital expenditures). However, the size of capital expenditures relative to the depreciation allowance depends substantially on a facility's return on assets. Facilities with lower return on assets tend to invest less than indicated by depreciation while facilities with higher return on assets tend to invest more than depreciation. This finding is consistent with the expectation that businesses with higher financial performance will have relatively more attractive investment opportunities and are more likely to attract the capital to undertake those investments. To highlight this relationship between capital expenditure, depreciation allowance, and a facility's return on assets, EPA presents graphs for the Hardware, Iron & Steel, Job Shops, and Printed Circuit Board sectors that plot MP&M survey facilities in these sectors along with linear trend lines for each sector's depreciation and capital expenditures with respect to return on assets.⁴

⁴ For presentation purposes, some outlier facilities were excluded from the graphs.

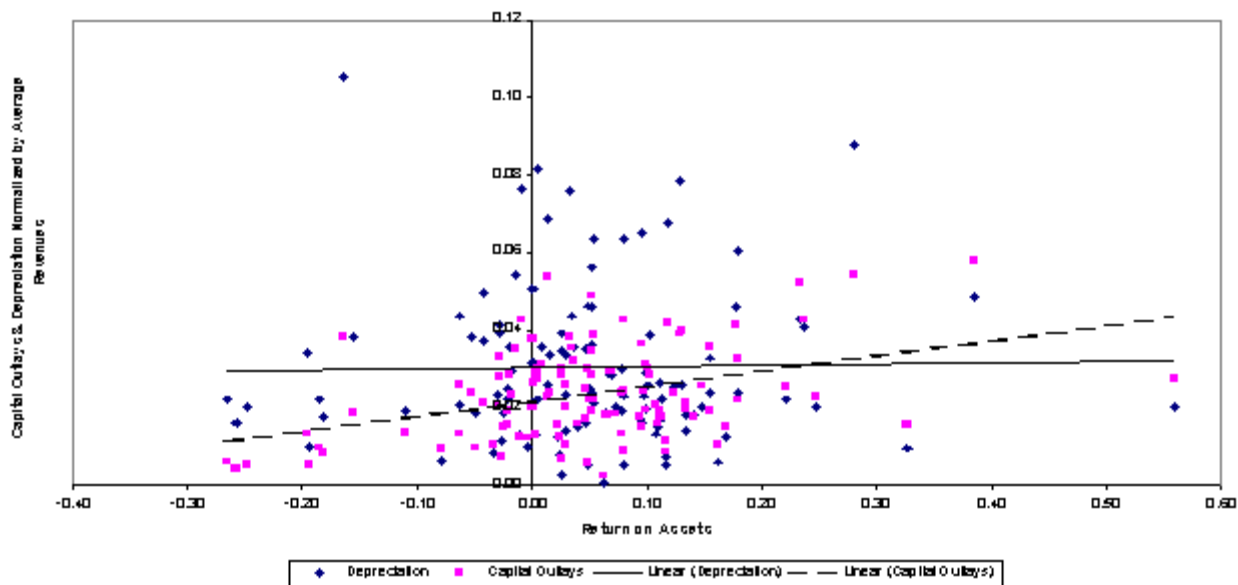
Table D.5: Estimation of Capital Outlays for MP&M Sample Facilities: Median Facilities Selected by Revenue and ROA Percentiles

Sectors	Pre-Tax Return on Assets (ROA)	Revenue	Capital Turnover Rate	Capital Intensity	Cost of Debt	Price of Capital Goods	Capacity Utilization	Estimated Capital Expenditures	Depreciation	Difference between Depreciation and Capital Expenditures
Coefficient Intercept (-2.077)	0.62	1.03	0.60	0.98	(0.21)	(0.48)	0.90			
Aerospace	0.02	90.66	0.02	1.29	7.11	135.4	73.67	2,113,741	1,821,434	-0.14
Aircraft	0.05	18.39	0.06	0.54	9.8	115.87	80.01	440,385	558,478	0.27
Bus & Truck	0.06	58.09	0.03	0.25	7.11	135.4	73.69	471,199	503,124	0.07
Electronic Equipment	0.05	36.85	0.12	0.4	7.11	135.4	86.37	1,100,627	1,730,023	0.57
Hardware	0.03	11.99	0.06	0.61	9.8	115.87	81.93	311,085	403,535	0.3
Household Equipment	0.05	18	0.05	0.8	7.11	135.4	84.24	624,804	745,476	0.19
Instruments	0.15	62.47	0.04	0.47	7.11	135.4	77.21	1,195,144	1,139,873	-0.05
Iron & Steel	0.12	23.17	0.06	0.47	6.4	136.9	90.82	617,740	613,834	-0.01
Job Shop	0.03	2	0.07	0.26	7.11	135.4	81.92	25,146	37,250	0.48
Mobile Industrial Equipment	0.07	37.6	0.03	0.63	9.8	115.87	79.45	670,447	586,609	-0.13
Motor Vehicle	0.1	104.44	0.06	0.46	7.11	135.4	81.24	2,473,215	2,810,386	0.14
Office Machine	0.1	28.95	0.06	0.43	7.11	135.4	85.02	661,715	748,972	0.13
Ordnance	0.05	27.08	0.04	0.65	9.8	115.87	79.77	674,446	770,051	0.14
Other Metal Products	0.08	27.78	0.17	0.44	7.11	135.4	80.01	1,100,691	2,034,831	0.85
Precious Metals & Jewelry	0.04	13.5	0.03	0.62	7.11	135.4	77.21	224,438	226,708	0.01

For facilities that responded to the Phase 1 survey, EPA calculated a 3-year average of the non-facility specific information over the years in which survey data were collected (1987-1989). Likewise, for facilities that responded to the Phase 2 survey, EPA calculated a 3-year average of the non-facility specific information for the years 1994-1996. Since the Iron and Steel sector was surveyed in 1997, EPA calculated a 3-year average of the non-facility specific information for the years 1995-1997.

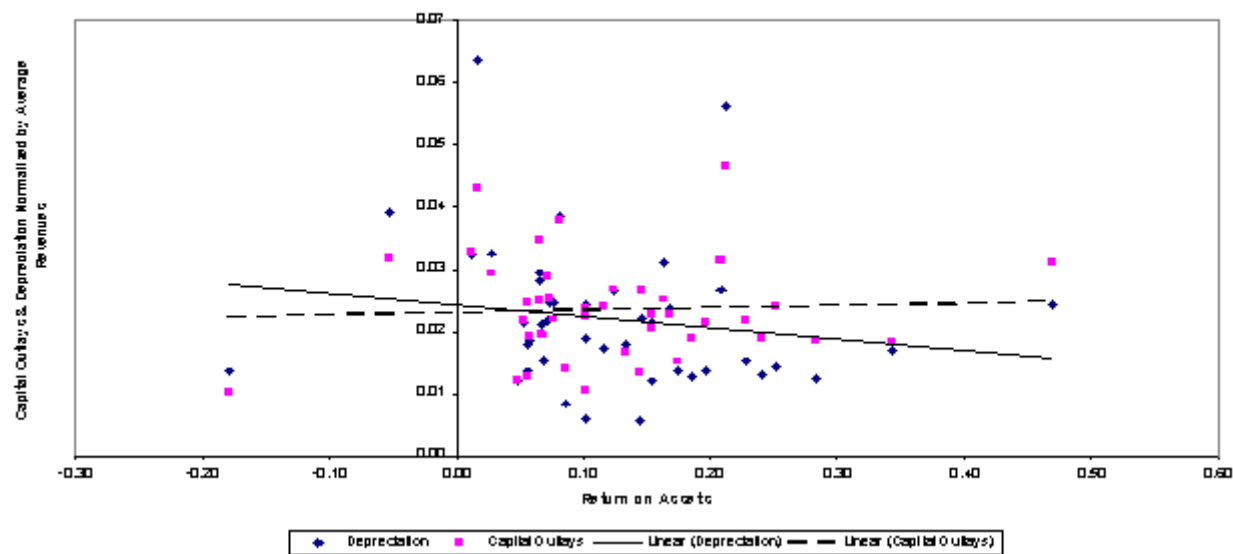
Source: U.S. EPA analysis

Figure D.1: Comparison of Estimated Capital Outlays to Reported Depreciation for MP&M Survey Facilities in the Hardware Sector



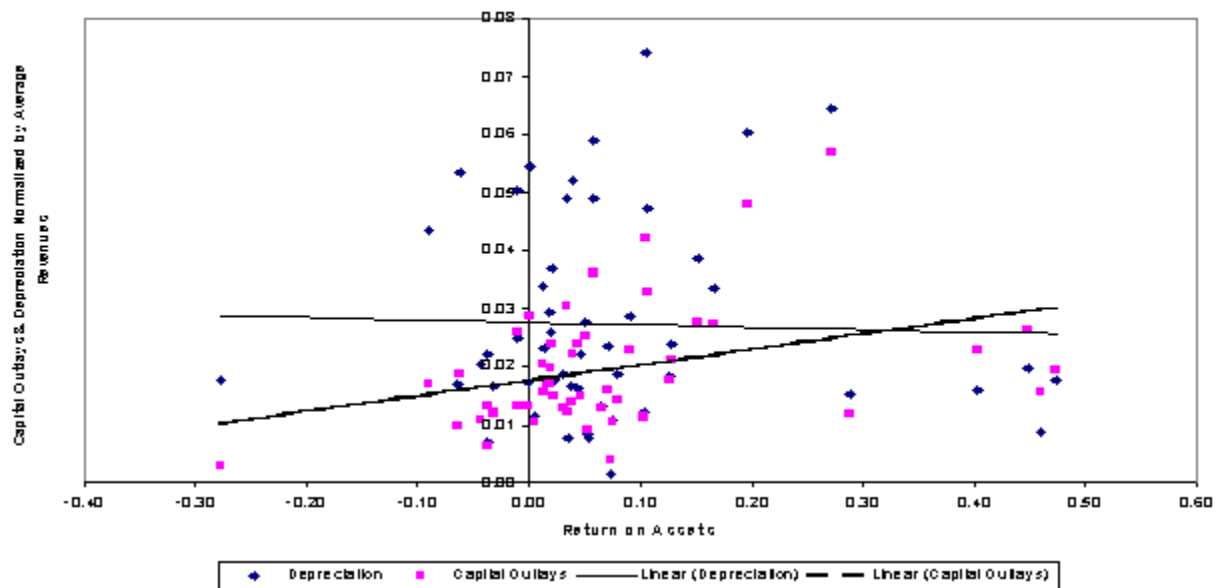
Source: U.S. EPA analysis.

Figure D.2: Comparison of Estimated Capital Outlays to Reported Depreciation for MP&M Survey Facilities in the Iron & Steel Sector



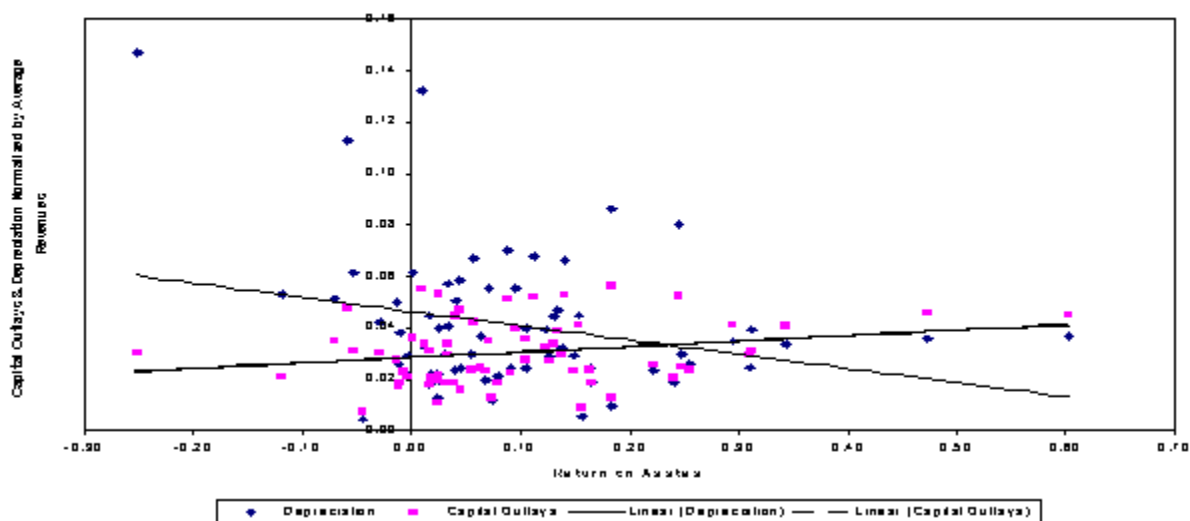
Source: U.S. EPA analysis.

Figure D.3: Comparison of Estimated Capital Outlays to Reported Depreciation for MP&M Survey Facilities in the Job Shop Sector



Source: U.S. EPA analysis.

Figure D.4: Comparison of Estimated Capital Outlays to Reported Depreciation for MP&M Survey Facilities in the Printed Circuit Board Sector



Source: U.S. EPA analysis.

ATTACHMENT D.A: BIBLIOGRAPHY OF LITERATURE REVIEWED FOR THIS ANALYSIS

As noted above, EPA relied on previous studies of investment behavior to select critical determinants of firms' capital expenditures. Empirical results from these studies suggest that investment is most sensitive to quantity variables (output or sales), return-over-cost, and capital utilization (R. Chirinko). Empirical results from more recent studies further found that increasing depreciation rates and capital equipment prices were of first-order importance in the equipment investment behavior in the 1990 (T. Tevlin, K. Whelan). Specifically, declining prices of micro-processor based equipment played a crucial role in the investment boom in the 1990.

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ATTACHMENT D.B: HISTORICAL VARIABLES CONTAINED IN THE VALUE LINE INVESTMENT SURVEY DATASET

All variables are provided for 10 years (except where a firm has been publicly reported for less than 10 years):

- Price of Common Stock
- Revenues
- Operating Income
- Operating Margin
- Net Profit Margin
- Depreciation
- Working Capital
- Cash Flow per share
- Dividends Declared per share
- Capital Spending per share
- Revenues per share
- Average Annual Price-Earnings Ratio
- Relative Price-Earnings Ratio
- Average Annual Dividend
- Return Total Capital
- Return Shareholders Equity
- Retained To Common Equity
- All Dividends To Net Worth
- Employees
- Net Profit
- Income Tax Rate
- Earnings Before Extras
- Earnings per share
- Long Term Debt
- Total Loans
- Total Assets
- Preferred Dividends
- Common Dividends
- Book Value
- Book Value per share
- Shareholder Equity
- Preferred Equity
- Common Shares Outstanding
- Average Shares Outstanding
- Beta
- Alpha
- Standard Deviation

Appendix E: Calculation of Capital Cost Components

INTRODUCTION

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E.1 Calculation of One-Time Capital Cost Estimates E-1

E.1 CALCULATION OF ONE-TIME CAPITAL COST COMPONENTS

EPA used the engineering estimates of total one-time capital costs to calculate the purchase cost paid to manufacturers of compliance equipment, and the costs of shipping, installation, insurance, engineering, and consultants. Two components of capital costs were used to estimate job gains due to compliance requirements: (1) the estimated direct capital equipment cost and (2) the labor cost of installation. Table E.1 shows the cost components that comprise the total capital costs attributed to the regulation.

Table E.1: Components of Total Installed Capital Costs (millions, 2001\$, before tax) ^a				
Cost Component	Option I: Selected Option	Option II: Proposed/ NODA Option	Option III: 413 to 433 Upgrade Option	Option IV: All to 433 Upgrade Option
(a) Total installed direct capital costs	\$4,407,590	\$802,051,833	\$95,552,532	\$148,434,303
(b) Direct capital equipment cost	\$3,070,680	\$558,773,471	\$66,569,538	\$103,411,210
(c) Shipping (20% of a)	\$881,518	\$160,410,367	\$19,110,506	\$29,686,861
(d) Labor cost of installation (7% of f)	\$455,392	\$82,867,995	\$9,872,488	\$15,336,232
(e) Indirect costs: insurance, engineering & consultants (47.6% of a)	\$2,098,013	\$381,776,672	\$45,483,005	\$70,654,728
(f) Total installed capital costs	\$6,505,602	\$1,183,828,505	\$141,035,538	\$219,089,032

^a Excludes costs for baseline and regulatory closures.

Source: U.S. EPA analysis.

The components of total capital costs for the final rule in Table E.1 are discussed below in reverse order of the table presentation.

- **Total installed capital costs:** EPA estimated the total one-time capital cost for each facility expected to comply with the regulation.¹ Compliance costs are discussed in more detail in *Chapter 5: Facility-Level Impact Analysis* of this EEBA. The national estimate of capital costs for the regulation is \$6.5 million (\$2001).²

¹ See the *Technical Development Document* for a description of the methods used to estimate capital costs.

² The \$6.5 million is the sum of one-time outlays for purchasing and installing the capital equipment needed to comply with the final rule. This expense is not the annual equivalent of that capital investment. The capital outlay is annualized in the economic impact analysis over a 15-year period. The resulting value, which is part of the total annual cost of compliance, is \$0.7 million.

- ▶ **Indirect Costs:** MP&M project engineers estimate that indirect costs such as insurance, engineering, and consulting are 47.6% of installed direct capital cost. EPA calculated the total direct and indirect cost using the total capital cost. The national estimate of indirect costs for the regulation is \$2.1 million.
- ▶ **Total Installed Direct Capital Costs:** The direct capital costs include the cost of compliance equipment, shipping, and the labor cost of installation. The national estimate of direct costs for the regulation is \$4.4 million. MP&M project engineers estimate that shipping costs might be as much as 20 percent of the total installed direct capital cost. The estimated one-time shipping cost is \$0.9 million for the final regulatory option. Installation labor costs are estimated by the engineers to be seven percent of the total installed capital costs. The estimated one-time cost of installation labor is \$0.5 million for the final regulatory option. Therefore, the direct capital equipment cost is \$3.1 million, the remainder of the total installed direct capital cost when the cost of shipping and installation are subtracted out.

Appendix F: Administrative Costs

INTRODUCTION

Effluent guidelines and limitations are implemented by Federal, State, and local government entities through the NPDES permit program (for direct dischargers) and the General Pretreatment Regulations (for indirect dischargers). A new effluent guideline rule may require that facilities: (1) be permitted for the first time; (2) be issued a different form of permit, if they already have a permit in the baseline; and (3) be re-permitted sooner than would otherwise be required. In these cases, the permitting authority will incur additional costs to implement the effluent guideline rule.

This appendix provides information on the unit costs of these permitting activities and describes the calculation of government permitting costs for the final MP&M rule and regulatory alternatives. EPA expects no additional costs for permitting direct dischargers under the final rule. Costs for issuing permits for indirect dischargers are based on information reported by publicly-owned treatment works (POTWs) in the Metal Products and Machinery (MP&M) POTW Survey. EPA also used the data provided in the Association of Metropolitan Sewerage Agencies (AMSA) survey to supplement information from the MP&M POTW Survey. EPA evaluated POTW administrative costs for pretreatment options for the final rule. As discussed in Section VI of the preamble to the final rule, EPA is not establishing any pretreatment standards in the final rule.

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The remainder of this appendix is organized as follows: Section F.1 provides an overview of permitting requirements under the NPDES Permit Program and the General Pretreatment Regulations. Section F.2 describes the MP&M POTW Survey and the methods used to develop annualized cost estimates for permitting indirect dischargers. Section F.3 presents the estimates of unit costs by permitting activity for indirect dischargers. The final Section F.4 lists the steps involved in applying these unit costs to calculate administrative costs for regulatory options evaluated by EPA for the final rule.

F.1 EFFLUENT GUIDELINES PERMITTING REQUIREMENTS

Any facility that directly discharges wastewater to surface water is required to have a permit issued under the National Pollution Discharge Elimination System (NPDES) permit program. Facilities that discharge indirectly through a POTW are regulated by the General Pretreatment Regulations for Existing and New Sources of Pollution (40 CFR Part 403). The major portion of government administrative costs associated with implementing an effluent guidelines rule are the costs of managing the NPDES and Pretreatment programs.

F.1.1 NPDES Basic Industrial Permit Program

Best Practical Technology (BPT), Best Control Technology (BCT), and New Source Performance Standards (NSPS) for effluent limitations guidelines are implemented through the NPDES industrial permit program. However, EPA does not expect the administrative costs associated with the NPDES industrial permit program to increase as a result of the final rule. The Clean Water Act prohibits discharge of any pollutant to a water of the U.S. except as permitted by a NPDES permit. Therefore, every facility that discharges wastewater directly to surface water must hold a permit specifying the mass of pollutants that can be discharged to waterways. The final rule will affect the terms of the permits but is unlikely to increase the administrative costs associated with permitting.

The final rule may decrease the administrative burden of NPDES permits. The TDD and rulemaking record for the final rule

provide valuable information to permitting authorities that may reduce the research required to develop Best Professional Judgment (BPJ) permits.¹ Further, establishing discharge standards may reduce time spent by permitting authorities establishing limits and the frequency of evidentiary hearings. The promulgation of limitations may also enable EPA and the authorized States to cover more facilities under general permits. General permits are single permits covering a common class of dischargers in a specified geographic area.

F.1.2 Pretreatment Program

The General Pretreatment Regulations (40 CFR Part 403) establish procedures, responsibilities, and requirements for EPA, States, local governments, and industry to control pollutant discharges to POTWs. Under the Pretreatment Regulations, POTWs or approved States implement categorical pretreatment standards for existing sources (PSES) and new sources (PSNS).

Discharges from an MP&M facility² to a POTW may already be permitted in the baseline.³ For example, industrial users subject to another Categorical Pretreatment Standard would have a discharge permit. Other significant industrial users (SIU) that are typically permitted by POTWs include industrial users that:

- ▶ discharge an average of 25,000 gallons per day or more of process wastewater to a POTW,
- ▶ contribute a process waste stream that makes up five percent or more of the average dry weather hydraulic or organic capacity of the POTW treatment plant, or
- ▶ have a reasonable potential for adversely affecting the POTW's operation or for violating any pretreatment standard.

As discussed in Section VI of the preamble to the final rule, EPA did not establish or revise any pretreatment standards in the final rule. Consequently, there are no POTW administrative costs associated with the final rule. Under the options evaluated for the final rule, which include options for setting pretreatment standards, EPA expects no increase in permitting costs for indirect dischargers that already hold a permit in the baseline. However, governments will incur additional permitting costs for unpermitted facilities (under the NODA/Proposal option only) and to accelerate repermitting for some indirect dischargers that currently hold permits. The remainder of this appendix estimates these cost increases. As with direct industrial dischargers, promulgation of the MP&M rule may cause some administrative costs to decrease. For example, control authorities will no longer have to repermit facilities that are estimated to close as a result of some of the options EPA evaluated for the final rule. These cost savings are reflected in estimates of total government administrative costs associated with the regulatory options considered for the final rule.

F.2 POTW ADMINISTRATIVE COST METHODOLOGY

F.2.1 Data Sources

EPA collected information from POTWs to support development of the MP&M effluent guideline (see Section 3 of the TDD). Of 150 surveys mailed, EPA received responses to 147, for a 98 percent response rate. The POTW Survey asked respondents to provide information on administrative permitting costs for indirect dischargers, sewage sludge use and disposal costs and practices, and general information (including number of permitted users and number of known MP&M dischargers). The administrative cost information included the number of hours required to complete specific permitting and repermitting,

¹ Permits issued to facilities not covered by effluent guidelines or water quality-based standards are developed based on BPJ (see NPDES' permit writers manual).

² MP&M facilities are defined on the basis of three considerations: (1) they produce metal parts, products, or machines for use in one of the 19 industry sectors evaluated for coverage in the MP&M point source category; (2) they use operations in one of the eight regulatory subcategories evaluated for coverage in the MP&M point source category; and (3) they discharge process wastewater, either directly or indirectly, to surface waters. In this document, the term "MP&M facilities" refers to all facilities meeting the above definition, regardless of whether a facility's industrial sector, subcategory, or discharger category is covered by the final regulation.

³ Under the General Pretreatment Program, a facility's discharges may be controlled through a "permit, order or similar means". For simplicity, this document refers to the control mechanism as a permit.

inspection, monitoring, and enforcement activities. Respondents were also asked to provide an average labor cost for all staff involved in permitting activities. EPA used the survey responses on administrative costs to estimate a range of costs incurred by POTWs to permit a single MP&M facility.

The Association of Metropolitan Sewerage Agencies (AMSA) also provided data on administrative costs to EPA (see Section 3 of the TDD). EPA used the data provided in the AMSA survey to verify and, in some cases, supplement its own analyses of POTW administrative costs for regulatory options evaluated for the final rule. AMSA provided EPA with comments on the proposed MP&M rule and supplemented these comments with a spreadsheet database. The database contains data from an AMSA formulated survey and covers responses from 176 POTWs, representing 66 pretreatment programs. The AMSA survey was conducted to verify data from EPA's survey of POTWs and therefore included similar, although fewer, variables compared to EPA's survey. Elements EPA verified using the AMSA survey include: (1) the estimated number of indirect dischargers; and (2) the unit costs of certain permitting activities, including permit implementation, sampling, and sample analysis. Elements EPA added to its analysis using the AMSA data include: (1) screening costs for POTWs that do not currently operate under a pretreatment program; and (2) oversight costs associated with implementing the MP&M regulation.

F.2.2 Overview of Methodology

EPA estimated the annualized costs of permitting indirect dischargers under the different regulatory options evaluated for the final rule using the following steps:

- ▶ **Determine the number and characteristics of indirect dischargers that will be permitted under each regulatory option evaluated for the final rule.** Only the NODA option includes costs for permitting an MP&M facility for the first time. The final rule does not cover indirect dischargers while the other regulatory options only regulate those indirect dischargers that already hold permits in the baseline. For the NODA option, EPA determined how many new permits would be issued. The NODA option requires only concentration-based permits, no mass-based permits.
- ▶ **Use the data from the POTW Survey to determine a high, middle, and low hourly burden for permitting a single facility.** EPA defined the low and high estimates of hours such that 90% of the POTW responses fell above the low value and 90% of responses fell below the high value. The median value is used to define the middle hourly burden.
- ▶ **Use the data from the POTW Survey to determine the average frequency of performing certain administrative functions.** For administrative functions that are not performed at all facilities, survey data were used to calculate the portion of facilities requiring these functions. For example, the survey data show that on average 38.5% of facilities submit a non-compliance report.
- ▶ **Multiply the per-facility burden estimate by the average hourly wage.** EPA determined a high, middle, and low dollar cost of administering the rule for a single facility by multiplying the per-facility hour burden by the average hourly wage. The POTW Survey reported an average hourly labor rate of \$39.33 (\$2001) for staff involved in permitting. This is a fully-loaded cost, including salaries and fringe benefits.
- ▶ **Calculate the annualized cost of administering the rule.** The number of facilities, hourly burden estimate, frequency estimates, and hourly wage estimates are all combined to determine the total cost of administering the rule. The type of administrative activities required varies over time and the total administrative cost is calculated over a 15 year time period. EPA calculated the present value of total costs using a seven percent discount rate, and then annualized the present value using the same seven percent discount rate.

F.3 UNIT COSTS OF PERMITTING ACTIVITIES

This section presents unit costs for the following permitting activities:

- ▶ **Permit application and issuance:** developing and issuing concentration-based permits at previously unpermitted facilities; providing technical guidance; and conducting public and evidentiary hearings;
- ▶ **Inspection:** inspecting facilities both for the initial permit development and to assess subsequent compliance;

- ▶ **Monitoring:** sampling and analyzing permittee's effluent; reviewing and recording permittee's compliance self-monitoring reports; receiving, processing, and acting on a permittee's non-compliance reports; and reviewing a permittee's compliance schedule report for permittees in compliance and permittees not in compliance;
- ▶ **Enforcement:** issuing administrative orders and administrative fines; and
- ▶ **Repermitting.**

EPA believes that these functions constitute the bulk of the required administrative activities. To these costs, EPA added a provision for managerial oversight of 25 percent.⁴ There are other relatively minor or infrequent administrative functions (e.g., providing technical guidance to permittees in years other than the first year of the permit, or repermitting a facility in significant non-compliance), but their costs are likely to be insignificant compared to the estimated costs for the five major categories outlined above. EPA also added a cost for identifying facilities to be permitted for POTWs that do not currently operate under a Pretreatment Program. EPA estimates this cost to be approximately \$0.8 million. This cost only applies to the NODA/Proposal Option since facilities subject to the upgrade options already hold permits.

For each major administrative function, this section provides below: (1) a description of the activities involved, (2) the estimated percentage of facilities that require the administrative function; (3) the frequency with which the function is performed, and (4) high, middle, and low estimates of per facility hours and costs. All costs are presented in year 2001 dollars.

F.3.1 Permit Application and Issuance

Before issuing a wastewater discharge permit to a facility, the permit authority typically inspects the facility, monitors the facility's wastewater, and completes pollutant limits calculations and permit paperwork. This section discusses the costs of completing limits calculations and paperwork; subsequent sections address inspection and monitoring costs. This section also discusses the costs of technical assistance that the control authority may provide facilities to facilitate compliance with new limits. Finally, this section includes the costs of public and evidentiary hearings that may be required for some permits.

a. Issue a concentration-based permit at a previously unpermitted facility

To issue a concentration-based permit, permit authorities first review permit applications for completeness. If an application is incomplete, the authorities notify the applicant and request the missing information. Completed applications are assigned to permit writers, who review the applications in more detail as they develop permit conditions. The effort required to complete these activities depends, in part, on the extent to which the permit authority has automated the permitting process.

EPA assumed that one-third of facilities will be permitted in each of the three years following the rule's effective date because compliance is mandated within three years of the date the standard is effective (40 CFR Section 403.6). EPA further assumed that facilities are repermited in five year cycles. (The administrative costs of repermitting are discussed separately below.) The actual number of facilities that are permitted each year is likely to differ somewhat from EPA's simplifying assumption. These minor differences in permit timing are not expected to significantly change the estimated administrative costs.

⁴ The 25 percent oversight cost provision is based on comments and data received from the Association of Metropolitan Sewerage Agencies (AMSA).

Table F.1: Administrative Activity: Develop and issue a concentration-based permit at a previously unpermitted facility

Percent of facilities for which activity is required	Frequency of activity	Typical costs (2001\$)		
		Low	Median	High
100% of unpermitted MP&M facilities (applicable to NODA/Proposal option only)	One time	4.0 hours; \$122	10.0 hours; \$304	40.0 hours; \$1,217

Source: U.S. EPA analysis of POTW Survey responses; U.S. Department of Labor, Bureau of Labor Statistics.

b. Issue a mass-based permit for a previously unpermitted facility⁵

The same administrative activities required to issue a concentration-based permit are also required for a mass-based permit. In addition, for mass-based permits issued under the MP&M rule, the permit writer must determine whether the facility practices pollution prevention and water conservation methods equivalent to those specified as the basis for BPT. If so, the permitting authority must determine the facility's historical flow rate. If not, the authority must derive a mass-based limit based on other factors such as production rates. When a facility matches BPT water conservation practices and provides historic flow data, development of a mass-based permit is a relatively straight-forward process. However, the task will be more challenging at a facility practicing only limited water conservation, particularly if the facility has multiple production units and generates integrated process and sanitary wastewaters.

Table F.2: Administrative Activity: Develop and issue a mass-based permit at a previously unpermitted facility

Percent of facilities for which activity is required	Frequency of activity	Typical costs (2001\$)		
		Low	Median	High
100% of MP&M facilities being issued a new mass-based permit (estimates used for the proposed rule)	One time	4.0 hours; \$122	13.0 hours; \$396	40.0 hours; \$1,217

Source: U.S. EPA analysis of POTW Survey responses; U.S. Department of Labor, Bureau of Labor Statistics.

c. Issue a mass-based permit for a facility with a concentration-based permit⁶

Some of the activities described above for issuing a mass-based permit will be simplified in cases where the facility already holds a concentration-based permit. For example, much of the basic information required in the permitting application will already be in the permitting authorities' records. However, the potentially labor-intensive task of determining the flow basis for the permit remains.

⁵ None of the regulatory options considered for the final rule require issuance of mass-based permits for previously unpermitted facilities. However, since these costs were developed for the proposed rule, they are presented in this appendix even though they are not used in the administrative costs estimates.

⁶ None of the regulatory options considered for the final rule require conversion of a concentration-based to a mass-based permit. However, since these costs were developed for the proposed rule, they are presented in this appendix even though they are not used in the administrative costs estimates.

Table F.3: Administrative Activity: Develop and issue a mass-based permit at a facility holding a concentration-based permit

Percent of facilities for which activity is required	Frequency of activity	Typical costs (2001\$)		
		Low	Median	High
100% of MP&M facilities with permit conversion (estimates used for the proposed rule)	One time	2.0 hours; \$61	8.0 hours; \$243	20.0 hours; \$608

Source: U.S. EPA analysis of POTW Survey responses; U.S. Department of Labor, Bureau of Labor Statistics.

d. Provide technical guidance to a permittee

Technical guidance is frequently provided by permit authorities to permittees concurrent with the issuance of a new permit. There are no legal requirements that a permit authority provide a permittee with technical guidance. However, such guidance is generally in the interest of all parties as it can expedite the permitting process, accelerate the permittee's compliance, and reduce the compliance burden. The extent of technical guidance provided varies dramatically among permit authorities. In some cases, a permit authority may hold a one-day workshop to provide information on a new pretreatment standard to facilities. In other cases, a permit authority may meet extensively with individual permittees to educate them regarding their responsibilities under pretreatment standards. The range of technical guidance appears to depend on whether the permittee already has a wastewater permit, whether the permittee is part of a multi-facility company, the resources of the permit authority, and the extent to which the permit authority has written or standardized guidance available for dissemination.

EPA assumed that permit authorities provide technical guidance to all facilities being issued a new mass-based or concentration-based permit under the MP&M pretreatment standards. Costs for technical guidance were estimated separately for facilities receiving a concentration-based permit and facilities receiving a mass-based permit. EPA assumed that technical guidance is provided in the year the initial permit is issued.

Table F.4: Administrative Activity: Provide technical guidance to permittee on permit compliance

Percent of facilities for which activity is required	Frequency of activity	Typical costs (2001\$)		
		Low	Median	High
100% of MP&M facilities being issued a new concentration-based permit (applicable to NODA/Proposal option only)	One time	1.5 hours; \$46	4.0 hours; \$122	12.0 hours; \$365
100% of MP&M facilities being issued a new mass-based permit (estimates used for the proposed rule)	One time	2.0 hours; \$61	4.0 hours; \$122	12.0 hours; \$365

Source: U.S. EPA analysis of POTW Survey responses; U.S. Department of Labor, Bureau of Labor Statistics.

e. Conduct a public or evidentiary hearing on a proposed permit

Federal regulations provide for a period during which the public may submit written comments on a proposed permit for direct dischargers and/or request that a public hearing be held. Permitting authorities for indirect dischargers may have the same requirements. Thus, proposed permits for indirect dischargers may be subject to public comments and hearings. Pretreatment public hearings are typically conducted at a scheduled local government (e.g., City Council) meeting. The meetings may require substantial preparation.

Federal regulations also provide for evidentiary hearings following final permit determination for direct dischargers. Again, permitting authorities for indirect dischargers may have these requirements as well. Thus, final permit determinations for indirect dischargers may be subject to evidentiary hearings.

Data from the POTW Survey indicated that a public or evidentiary hearing would be required for 3.6% of indirect dischargers being issued a new mass-based or concentration-based permit, on average.

Table F.5: Administrative Activity: Conduct a public or evidentiary hearing				
Percent of facilities for which activity is required	Frequency of activity	Typical costs (2001\$)		
		Low	Median	High
3.2% of MP&M facilities being issued a new mass-based or concentration-based permit (applicable to NODA/Proposal option only)	One time	2.0 hours; \$61	8.0 hours; \$243	40.0 hours; \$1,217

Source: U.S. EPA analysis of POTW Survey responses; U.S. Department of Labor, Bureau of Labor Statistics.

F.3.2 Inspection

Permit authorities may choose to integrate their inspection and monitoring work force or to administer these functions separately. This discussion covers inspections only; monitoring is discussed below. Inspections are performed both to assess conditions for initial permitting and to evaluate compliance with permit requirements. Inspections involve record reviews, visual observations, and evaluations of the treatment facilities, effluents, receiving waters, etc. EPA assumed that the initial inspection would occur in the same year a new permit is issued, and that all permitted facilities would be inspected annually to assess compliance.

Table F.6: Administrative Activity: Inspect facility for permit development				
Percent of facilities for which activity is required	Frequency of activity	Typical costs (2001\$)		
		Low	Median	High
100% of MP&M facilities being issued a new permit (applicable to NODA/Proposal option only)	One Time	2.2 hours; \$66	5.0 hours; \$152	12.0 hours; \$365

Source: U.S. EPA analysis of POTW Survey responses; U.S. Department of Labor, Bureau of Labor Statistics.

Table F.7: Administrative Activity: Inspect facility for compliance assessment				
Percent of facilities for which activity is required	Frequency of activity	Typical costs (2001\$)		
		Low	Median	High
100% of MP&M facilities being issued a new permit (applicable to NODA/Proposal option only)	Annual	2.0 hours; \$61	3.3 hours; \$101	10.0 hours; \$304

Source: U.S. EPA analysis of POTW Survey responses; U.S. Department of Labor, Bureau of Labor Statistics.

F.3.3 Monitoring

Permitting authorities monitor facilities both to gather data needed for permit development and to assess compliance with permit conditions. Monitoring includes sampling and analysis of the permittee's effluent, review of the permittee's compliance self-monitoring reports, receipt of non-compliance reports, and review of compliance schedule reports. These activities are discussed below.

a. Sample and analyze permittee's effluent

As noted above, inspection and monitoring staff may be integrated or distinct. The costs of inspection were presented above. Federal regulations require that the permit authority "randomly sample and analyze the effluent from industrial users ... independent of information supplied by industrial users" (40 CFR Part 403.8). The permit authority obtains samples required by the permit and performs chemical analyses. The results are used to verify the accuracy of the permittee's self-monitoring program and reports, determine the quantity and quality of effluents, develop permits, and provide evidence for enforcement proceedings where appropriate.

EPA estimated sampling costs for all facilities issued a new permit under the MP&M rule, and assumed annual monitoring. Although EPA requires only annual effluent sampling, some localities sample more frequently. EPA encourages this practice.

Table F.8: Administrative Activity: Sample and analyze permittee's effluent				
Percent of facilities for which activity is required	Frequency of activity	Typical costs (2001\$)		
		Low	Median	High
100% of MP&M facilities being issued a new permit (applicable to NODA/Proposal option only)	Annual	1.0 hour; \$30	3.0 hours; \$91	17.7 hours; \$537

Source: U.S. EPA analysis of POTW Survey responses; U.S. Department of Labor, Bureau of Labor Statistics.

b. Review and record permittee's compliance self-monitoring reports

40 CFR Part 403.12 specifies that: "Any Industrial User subject to a categorical pretreatment standard ... shall submit to the Control authority during the months of June and December ... a report indicating the nature and concentration of pollutants in the effluent which are limited by such categorical pretreatment standards." The permit authority briefly reviews these submissions and may enter the information into a computerized system and/or file the data.

EPA estimated the costs of handling annual self-monitoring reports for all facilities being issued a new permit under the MP&M rule.

Table F.9: Administrative Activity: Review and enter data from permittee's compliance self-monitoring reports				
Percent of facilities for which activity is required	Frequency of activity	Typical costs (2001\$)		
		Low	Median	High
100% of MP&M facilities being issued a new permit (applicable to NODA/Proposal option only)	2 reports per year	0.5 hours; \$15	1.0 hour; \$30	4.0 hours; \$122

Source: U.S. EPA analysis of POTW Survey responses; U.S. Department of Labor, Bureau of Labor Statistics.

c. Receive, process, and act on a permittee's non-compliance report

Generally, when a permittee violates a permit condition, it must submit a non-compliance report to the permit authority. Permittees report both unanticipated bypasses or upsets and violations of maximum daily discharge limits. The permit authority receives and processes both verbal and written non-compliance reports. In some cases, immediate action by the permit authority is required to mitigate the problem.

Data from the POTW Survey indicate that 38.5 percent of all facilities submit at least one non-compliance report annually. Of facilities that submit at least one non-compliance report, the median number of reports filed per year is five reports.

Table F.10: Administrative Activity: Receive, process and act on a permittee's non-compliance reports				
Percent of facilities for which activity is required	Frequency of activity	Typical costs (2001\$)		
		Low	Median	High
38.5% of all indirect dischargers receiving a new permit (applicable to NODA/Proposal option only)	5 times per year	1.0 hour; \$30	2.0 hours; \$61	6.0 hours; \$183

Source: U.S. EPA analysis of POTW Survey responses; U.S. Department of Labor, Bureau of Labor Statistics.

d. Review a permittee's compliance schedule report

Permittees submit reports to permit authorities that state whether compliance schedule milestones contained in their permits have been met. If the facility is in compliance, the permit authority reviews and files the report.

Data from the POTW Survey indicate that approximately 17% of all facilities are issued compliance milestones. Of these facilities, 94% meet the milestones. Facilities submit an average of two compliance milestone reports per year. The cost of handling the report depends on whether the facility is in compliance with the schedule.

Table F.11: Administrative Activity: Review a compliance schedule report				
Percent of facilities for which activity is required	Frequency of activity	Typical costs (2001\$)		
		Low	Median	High
Meeting milestones: 16.0% of all facilities issued a new permit – 94% of the 17% who have compliance milestones (applicable to NODA/Proposal option only)	2 reports per year	0.5 hours; \$15	1.0 hour; \$30	2.7 hours; \$81
Not meeting milestones: 1% of all facilities issued a new permit – 6% of the 17% who have compliance milestones (applicable to NODA/Proposal option only)	2 reports per year	1.0 hours; \$30	2.0 hours; \$61	6.0 hours; \$183

Source: U.S. EPA analysis of POTW Survey responses; U.S. Department of Labor, Bureau of Labor Statistics.

F.3.4 Enforcement

When a permitting authority identifies a permit violation, the authority determines and implements an appropriate enforcement action. Considerations when determining enforcement response include (1) the severity of the permit violation, (2) the degree of economic benefit obtained by the permittee through the violation, (3) previous enforcement actions taken against the violator, (4) the deterrent effect of the response on similarly situated permittees, and (5) considerations of fairness and equity. EPA estimated administrative costs for two levels of enforcement actions: (1) less severe actions such as issuing an administrative order, and (2) more severe activities such as levying an administrative fine.

EPA estimated that, annually, seven percent of facilities issued a new permit under the MP&M rule will require a minor enforcement action, such as issuing an administrative compliance order. In addition, EPA estimated that seven percent of facilities receiving a new permit will require more severe enforcement actions such as a fine or penalty.

Table F.12: Administrative Activity: Minor enforcement action e.g., issue an administrative order				
Percent of facilities for which activity is required	Frequency of activity	Typical costs (2001\$)		
		Low	Median	High
7% of MP&M facilities being issued a new permit (applicable to NODA/Proposal option only)	Annual	1.0 hour; \$30	3.7 hours; \$112	12.0 hours; \$365

Source: U.S. EPA analysis of POTW Survey responses; U.S. Department of Labor, Bureau of Labor Statistics.

Table F.13: Administrative Activity: Minor enforcement action, e.g., impose an administrative fine				
Percent of facilities for which activity is required	Frequency of activity	Typical costs (2001\$)		
		Low	Median	High
7% of MP&M facilities being issued a new permit (applicable to NODA/Proposal option only)	Annual	1.0 hour; \$30	5.0 hours; \$152	24.0 hours; \$730

Source: U.S. EPA analysis of POTW Survey responses; U.S. Department of Labor, Bureau of Labor Statistics.

F.3.5 Repermitting

The duration of permits cannot exceed five years. Renewing a permit for a facility in compliance with an existing permit is expected to be a relatively straightforward task. The data submitted in the permit application generally require few changes, although pollutant limits may need to be recalculated in some cases. The labor required for repermitting depends, in part, on the extent to which the permit authority has automated the paperwork.

Table F.14: Administrative Activity: Repermit				
Percent of facilities for which activity is required	Frequency of activity	Typical costs (2001\$)		
		Low	Median	High
100% of MP&M facilities being issued a new permit (applicable to NODA/Proposal option only)	every 5 years	1.0 hour; \$30	4.0 hours; \$122	20.0 hours; \$608

Source: U.S. EPA analysis of POTW Survey responses; U.S. Department of Labor, Bureau of Labor Statistics.

In addition to repermitting MP&M facilities being issued a new permit, EPA also considered two other types of cost: (1) the costs associated with repermitting facilities that already hold a permit in the baseline sooner than would otherwise be required; and (2) cost savings associated with no longer having to permit facilities that already hold a permit in the baseline but that are estimated to close as a result of the rule. Both cost components are reflected in the POTW administrative costs presented in the next section.

F.4 POTW ADMINISTRATIVE COSTS BY OPTION

Exhibits F.1 through F.7 at the end of this appendix present the calculation of POTW permitting costs for the final rule and the three regulatory alternatives considered by EPA.

Exhibit F.1 provides an overview of the permitting activities, the estimated percentage of facilities that require the administrative function, the frequency with the function is performed, and per facility hours and costs for each function.

Exhibit F.2 contains the per facility hour burden and other assumptions described above for each of the three types of permitting (new concentration-based permit, new mass-based permit, and converting a concentration-based to a mass-based permit.)

Exhibits F.3 through F.5 show hours by type of permit for the low, medium, and high estimate of per-facility burden, respectively. These exhibits also summarize costs and dollars by year and permit type.

Exhibit F.6 presents the number of facilities requiring different types of permitting, for each of the regulatory options. The exhibit shows the total number of facilities that will be subject to requirements, the baseline permit status of those facilities, and the number of facilities by expected post-compliance permit status. These estimates are based on facility survey information about baseline permit status and the results of the facility impact analysis described in Chapter 5 of the EEBA. The exhibit also shows the number of currently-permitted facilities that are projected to close as a result of the rule, and which will therefore no longer require re-permitting.

The final Exhibit F.7 shows the resulting calculation of POTW administrative hours and costs by year for each regulatory option. This exhibit also shows the present value of these costs, the annualized cost, and the maximum hours and costs incurred in any one year, for each option. These calculations reflect the incremental number of facilities requiring different types of permitting, inspection, monitoring, enforcement and repermitting in each year multiplied by the unit hours and cost per facility for those activities. All facilities are assumed to receive a permit under the final rule within the three-year compliance period. Some facilities with existing permits are re-permitted sooner than they otherwise would be on the normal five-year permitting cycle. The cost analyses calculates incremental costs by subtracting the costs of re-permitting these facilities on a five-year schedule from the costs of re-permitting all such facilities within three years. EPA assumes that the required initial permitting activities will be equally divided over the three-year period. The analysis also calculates the net

change in the number of facilities requiring permitting by subtracting the number of facilities that close due to the rule from the number of facilities that will require new permits under each regulatory option.

More detailed information on these cost calculations is provided in the docket for the final rule.

APPENDIX F EXHIBITS

Exhibit F.1:	Government Administrative Activities for Indirect Dischargers: Per Facility Hours and Costs
Exhibit F.2:	Per-Facility Hours and Assumptions
Exhibit F.3:	Low Estimate of Hours and Costs per Facility
Exhibit F.4:	Medium Estimate of Hours and Costs per Facility
Exhibit F.5:	High Estimate of Hours and Costs per Facility
Exhibit F.6:	Number of Facilities Requiring Additional Permitting
Exhibit F.7:	POTW Administrative Costs by Option

Exhibit F.1: Government Administrative Activities for Indirect Dischargers: Per Facility Hours and Costs					
Administrative Activity	Percent of facilities for which activity is required	Frequency of activity	Typical hours and costs		
			Low	Median	High
Develop and issue a concentration-based permit at a previously unpermitted facility	100% of unpermitted facilities (applicable to NODA/Proposal option only)	One time	4.0 hours; \$122	10.0 hours; \$304	40.0 hours; \$1,217
Develop and issue a mass-based permit at a previously unpermitted facility	100% of MP&M facilities being issued a new mass-based permit (estimates used for the proposed rule)	One time	4.0 hours; \$122	13.0 hours; \$396	40.0 hours; \$1,217
Develop and issue a mass-based permit at a facility holding a concentration-based permit	100% of MP&M facilities with permit conversion (estimates used for the proposed rule)	One time	2.0 hours; \$61	8.0 hours; \$243	20.0 hours; \$608 year
Provide technical guidance to a permittee on permit compliance	100% of MP&M facilities being issued a new concentration-based permit (applicable to NODA/Proposal option only)	One time	1.5 hour; \$46	4.0 hours; \$122	12.0 hours; \$365
	100% of MP&M facilities being issued a new mass-based permit (estimates used for the proposed rule)	One time	2.0 hours; \$61	4.0 hours; \$122	12.0 hours; \$365
Conduct a public or evidentiary hearing	3.2% of MP&M facilities being issued a new mass-based or concentration-based permit (applicable to NODA/Proposal option only)	One time	2.0 hours; \$61	8.0 hours; \$243	40.0 hours; \$1,217
Inspect facility for permit development	100% of MP&M facilities being issued a new permit (applicable to NODA/Proposal option only)	One Time	2.2 hours; \$66	5.0 hours; \$152	12.0 hours; \$365
Inspect facility for compliance assessment	100% of MP&M facilities being issued a new permit (applicable to NODA/Proposal option only)	Annual	2.0 hours; \$61	3.3 hours; \$101	10.0 hours; \$304
Sample and analyze permittee's effluent	100% of MP&M facilities being issued a new permit (applicable to NODA/Proposal option only)	Annual	1.0 hour; \$30	3.0 hours; \$91	17.7 hours; \$537
Review and enter data from permittee's compliance self-monitoring reports	100% of MP&M facilities being issued a new permit (applicable to NODA/Proposal option only)	2 reports per year	0.5 hours; \$15	1.0 hour; \$30	4.0 hours; \$122
Receive, process and act on a permittee's non-compliance reports	38.5% of all indirect dischargers receiving a new permit (applicable to NODA/Proposal option only)	5 times per year	1.0 hour; \$30	2.0 hours; \$61	6.0 hours; \$183
Review a compliance schedule report	Meeting milestones: 16.0% of all facilities issued a new permit – 94% of the 17% who have compliance milestones (applicable to NODA/Proposal option only)	2 reports per year	0.5 hours; \$15	1.0 hour; \$30	2.7 hours; \$81
	Not meeting milestones: 1% of all facilities issued a new permit – 6% of the 17% who have compliance milestones (applicable to NODA/Proposal option only)	2 reports per year	1.0 hours; \$30	2.0 hours; \$61	6.0 hours; \$183
Minor enforcement action e.g., issue an administrative order	7% of MP&M facilities being issued a new permit (applicable to NODA/Proposal option only)	Annual	1.0 hour; \$30	3.7 hours; \$112	12.0 hours; \$365
Minor enforcement action, e.g., impose an administrative fine	7% of MP&M facilities being issued a new permit (applicable to NODA/Proposal option only)	Annual	1.0 hour; \$30	5.0 hours; \$152	24.0 hours; \$730
Repermit	100% of MP&M facilities being issued a new permit (applicable to NODA/Proposal option only)	Every 5 years	1.0 hour; \$30	4.0 hours; \$122	20.0 hours; \$608

Source: Estimates of hours by activity from the 1996 MP&M POTW Survey. Average hourly rate from Bureau of Labor Statistics (Sept. 2002 rate, adjusted to \$2001).

Exhibit F.2: Per-Facility Hours and Assumptions						
Activity	Low	Medium	High	% Facil	x/yr	Notes
<i>New concentration-based permit</i>						
develop and issue permit	4.0	10.0	40.0	100.0%	1	one-time
provide technical guidance	1.5	4.0	12.0	100.0%	1	one-time
conduct public or evidentiary hearings	2.0	8.0	40.0	3.2%	1	one-time, 3.2% of facilities
inspection for permit development	2.2	5.0	12.0	100.0%	1	one-time
inspection for compliance assessment	2.0	3.3	10.0	100.0%	1	annual
sample and analyze effluent	1.0	3.0	17.7	100.0%	1	annual
review & record self-monitoring reports	0.5	1.0	4.0	100.0%	2	2x/year
process & act on non-compliance reports	1.0	2.0	6.0	38.5%	5	5x/year, 38.5% of facilities
review compliance schedule report - in compliance with schedule	0.5	1.0	2.7	16.0%	2	2x/yr, 17% of facilities with compliance milestones, of which 94% in compliance
review compliance schedule report - not in compliance with schedule	1.0	2.0	6.0	1.0%	2	2x/yr, 17% of facilities with compliance milestones, of which 6% not in compliance
minor enforcement action (e.g., admin order)	1.0	3.7	12.0	7.0%	1	annual, 7% of facilities
minor enforcement action (e.g., admin fine)	1.0	5.0	24.0	7.0%	1	annual, 7% of facilities
repermit	1.0	4.0	20.0	100.0%	1	every three years
<i>New mass-based permit</i>						
develop and issue permit	4.0	13.0	40.0	100.0%	1	one-time
provide technical guidance	2.0	4.0	12.0	100.0%	1	one-time
conduct public or evidentiary hearings	2.0	8.0	40.0	3.2%	1	one-time, 3.2% of facilities
inspection for permit development	2.2	5.0	12.0	100.0%	1	one-time
inspection for compliance assessment	2.0	3.3	10.0	100.0%	1	annual
sample and analyze effluent	1.0	3.0	17.7	100.0%	1	annual
review & record self-monitoring reports	0.5	1.0	4.0	100.0%	2	2x/year
process & act on non-compliance reports	1.0	2.0	6.0	38.5%	5	5x/year, 38.5% of facilities
review compliance schedule report - in compliance with schedule	0.5	1.0	2.7	16.0%	2	2x/yr, 17% of facilities with compliance milestones, of which 94% in compliance
review compliance schedule report - not in compliance with schedule	1.0	2.0	6.0	1.0%	2	2x/yr, 17% of facilities with compliance milestones, of which 6% not in compliance
minor enforcement action (e.g., admin order)	1.0	3.7	12.0	7.0%	1	annual, 7% of facilities
minor enforcement action (e.g., admin fine)	1.0	5.0	24.0	7.0%	1	annual, 7% of facilities
repermit	1.0	4.0	20.0	100.0%	1	every three years
<i>Converting concentration-based to mass-based</i>						
develop and issue permit	2.0	8.0	20.0	100.0%	1	one-time
provide technical guidance	0.0	0.0	0.0	0.0%	0	N/A

Exhibit F.2: Per-Facility Hours and Assumptions						
Activity	Low	Medium	High	% Facil	x/yr	Notes
conduct public or evidentiary hearings	0.0	0.0	0.0	0.0%	0	N/A
inspection for permit development	0.0	0.0	0.0	0.0%	0	N/A
inspection for compliance assessment	2.0	3.3	10.0	100.0%	1	annual
sample and analyze effluent	1.0	3.0	17.7	100.0%	1	annual
review & record self-monitoring reports	0.5	1.0	4.0	100.0%	2	2x/year
process & act on non-compliance reports	1.0	2.0	6.0	38.5%	5	5x/year, 38.5% of facilities
review compliance schedule report - in compliance with schedule	0.5	1.0	2.7	16.0%	2	2x/yr, 17% of facilities with compliance milestones, of which 94% in compliance
review compliance schedule report - not in compliance with schedule	1.0	2.0	6.0	1.0%	2	2x/yr, 17% of facilities with compliance milestones, of which 6% not in compliance
minor enforcement action (e.g., admin order)	1.0	3.7	12.0	7.0%	1	annual, 7% of facilities
minor enforcement action (e.g., admin fine)	1.0	5.0	24.0	7.0%	1	annual, 7% of facilities
repermit	1.0	4.0	20.0	100.0%	1	every three years

Discount rate: 7%

Average hourly rate: \$30.42 (\$2001)

Source: Estimates of hours by activity from the 1996 MP&M POTW Survey. Average hourly rate from Bureau of Labor Statistics (Sept. 2002 rate, adjusted to \$2001).

Exhibit F.3: Low Estimate of Hours and Costs per Facility (average considering frequency of activity and percent of facilities requiring activity)			
Activity	Initial Year	Annual (non-permitting year)	Repermit Year
<i>New concentration-based permit</i>			
develop and issue permit	4		
provide technical guidance	2		
conduct public or evidentiary hearings	0		
inspection for permit development	2		
inspection for compliance assessment	2	2	2
sample and analyze effluent	1	1	1
review & record self-monitoring reports	1	1	1
process & act on non-compliance reports	2	2	2
review compliance schedule report - in compliance with schedule	0	0	0
review compliance schedule report - not in compliance with schedule	0	0	0
minor enforcement action (e.g., admin order)	0	0	0
minor enforcement action (e.g., admin fine)	0	0	0
repermit			1
<i>Total Hours by Year</i>	<i>14</i>	<i>6</i>	<i>7</i>
<i>Total Dollars by Year</i>	<i>\$425</i>	<i>\$190</i>	<i>\$220</i>
<i>New mass-based permit</i>			
develop and issue permit	4		
provide technical guidance	2		
conduct public or evidentiary hearings	0		
inspection for permit development	2		
inspection for compliance assessment	2	2	2
sample and analyze effluent	1	1	1
review & record self-monitoring reports	1	1	1
process & act on non-compliance reports	2	2	2
review compliance schedule report - in compliance with schedule	0	0	0
review compliance schedule report - not in compliance with schedule	0	0	0
minor enforcement action (e.g., admin order)	0	0	0
minor enforcement action (e.g., admin fine)	0	0	0
repermit			1
<i>Total Hours by Year</i>	<i>14</i>	<i>6</i>	<i>7</i>
<i>Total Dollars by Year</i>	<i>\$440</i>	<i>\$190</i>	<i>\$220</i>
<i>Upgrading from concentration-based to mass-based</i>			
develop and issue permit	2		
provide technical guidance	0		
conduct public or evidentiary hearings	0		
inspection for permit development	0		
inspection for compliance assessment	2	2	2
sample and analyze effluent	1	1	1

Exhibit F.3: Low Estimate of Hours and Costs per Facility (average considering frequency of activity and percent of facilities requiring activity)			
Activity	Initial Year	Annual (non-permitting year)	Repermit Year
review & record self-monitoring reports	1	1	1
process & act on non-compliance reports	2	2	2
review compliance schedule report - in compliance with schedule	0	0	0
review compliance schedule report - not in compliance with schedule	0	0	0
minor enforcement action (e.g., admin order)	0	0	0
minor enforcement action (e.g., admin fine)	0	0	0
repermit			1
<i>Total Hours by Year</i>	8	6	7
<i>Total Dollars by Year</i>	\$251	\$190	\$220

Source: Estimates of hours by activity from the 1996 MP&M POTW Survey. Average hourly rate from Bureau of Labor Statistics (Sept. 2002 rate, adjusted to \$2001).

Exhibit F.4: Medium Estimate of Hours and Costs per Facility (average considering frequency of activity and percent of facilities requiring activity)			
Activity	Initial Year	Annual (non-permitting year)	Repermit Year
<i>New concentration-based permit</i>			
develop and issue permit	10		
provide technical guidance	4		
conduct public or evidentiary hearings	0		
inspection for permit development	5		
inspection for compliance assessment	3	3	3
sample and analyze effluent	3	3	3
review & record self-monitoring reports	2	2	2
process & act on non-compliance reports	4	4	4
review compliance schedule report - in compliance with schedule	0	0	0
review compliance schedule report - not in compliance with schedule	0	0	0
minor enforcement action (e.g., admin order)	0	0	0
minor enforcement action (e.g., admin fine)	0	0	0
repermit			4
<i>Total Hours by Year</i>	<i>32</i>	<i>13</i>	<i>17</i>
<i>Total Dollars by Year</i>	<i>\$986</i>	<i>\$400</i>	<i>\$522</i>
<i>New mass-based permit</i>			
develop and issue permit	13		
provide technical guidance	4		
conduct public or evidentiary hearings	0		
inspection for permit development	5		
inspection for compliance assessment	3	3	3
sample and analyze effluent	3	3	3
review & record self-monitoring reports	2	2	2
process & act on non-compliance reports	4	4	4
review compliance schedule report - in compliance with schedule	0	0	0
review compliance schedule report - not in compliance with schedule	0	0	0
minor enforcement action (e.g., admin order)	0	0	0
minor enforcement action (e.g., admin fine)	0	0	0
repermit			4
<i>Total Hours by Year</i>	<i>35</i>	<i>13</i>	<i>17</i>
<i>Total Dollars by Year</i>	<i>\$1,077</i>	<i>\$400</i>	<i>\$522</i>
<i>Upgrading from concentration-based to mass-based</i>			
develop and issue permit	8		
provide technical guidance	0		
conduct public or evidentiary hearings	0		
inspection for permit development	0		
inspection for compliance assessment	3	3	3

Exhibit F.4: Medium Estimate of Hours and Costs per Facility (average considering frequency of activity and percent of facilities requiring activity)			
Activity	Initial Year	Annual (non-permitting year)	Repermit Year
sample and analyze effluent	3	3	3
review & record self-monitoring reports	2	2	2
process & act on non-compliance reports	4	4	4
review compliance schedule report - in compliance with schedule	0	0	0
review compliance schedule report - not in compliance with schedule	0	0	0
minor enforcement action (e.g., admin order)	0	0	0
minor enforcement action (e.g., admin fine)	0	0	0
repermit			4
<i>Total Hours by Year</i>	<i>21</i>	<i>13</i>	<i>17</i>
<i>Total Dollars by Year</i>	<i>\$643</i>	<i>\$400</i>	<i>\$522</i>

Source: Estimates of hours by activity from the 1996 MP&M POTW Survey. Average hourly rate from Bureau of Labor Statistics (Sept. 2002 rate, adjusted to \$2001).

Exhibit F.5: High Estimate of Hours and Costs per Facility (average considering frequency of activity and percent of facilities requiring activity)			
Activity	Initial Year	Annual (non-permitting year)	Repermit Year
<i>New concentration-based permit</i>			
develop and issue permit	40		
provide technical guidance	12		
conduct public or evidentiary hearings	1		
inspection for permit development	12		
inspection for compliance assessment	10	10	10
sample and analyze effluent	18	18	18
review & record self-monitoring reports	8	8	8
process & act on non-compliance reports	12	12	12
review compliance schedule report - in compliance with schedule	1	1	1
review compliance schedule report - not in compliance with schedule	0	0	0
minor enforcement action (e.g., admin order)	1	1	1
minor enforcement action (e.g., admin fine)	2	2	2
repermit			20
<i>Total Hours by Year</i>	<i>116</i>	<i>51</i>	<i>71</i>
<i>Total Dollars by Year</i>	<i>\$3,529</i>	<i>\$1,543</i>	<i>\$2,151</i>
<i>New mass-based permit</i>			
develop and issue permit	40		
provide technical guidance	12		
conduct public or evidentiary hearings	1		
inspection for permit development	12		
inspection for compliance assessment	10	10	10
sample and analyze effluent	18	18	18
review & record self-monitoring reports	8	8	8
process & act on non-compliance reports	12	12	12
review compliance schedule report - in compliance with schedule	1	1	1
review compliance schedule report - not in compliance with schedule	0	0	0
minor enforcement action (e.g., admin order)	1	1	1
minor enforcement action (e.g., admin fine)	2	2	2
repermit			20
<i>Total Hours by Year</i>	<i>116</i>	<i>51</i>	<i>71</i>
<i>Total Dollars by Year</i>	<i>\$3,529</i>	<i>\$1,543</i>	<i>\$2,151</i>
<i>Upgrading from concentration-based to mass-based</i>			
develop and issue permit	20		
provide technical guidance	0		
conduct public or evidentiary hearings	0		
inspection for permit development	0		
inspection for compliance assessment	10	10	10

Exhibit F.5: High Estimate of Hours and Costs per Facility (average considering frequency of activity and percent of facilities requiring activity)			
Activity	Initial Year	Annual (non-permitting year)	Repermit Year
sample and analyze effluent	18	18	18
review & record self-monitoring reports	8	8	8
process & act on non-compliance reports	12	12	12
review compliance schedule report - in compliance with schedule	1	1	1
review compliance schedule report - not in compliance with schedule	0	0	0
minor enforcement action (e.g., admin order)	1	1	1
minor enforcement action (e.g., admin fine)	2	2	2
repermit			20
<i>Total Hours by Year</i>	<i>71</i>	<i>51</i>	<i>71</i>
<i>Total Dollars by Year</i>	<i>\$2,151</i>	<i>\$1,543</i>	<i>\$2,151</i>

Source: Estimates of hours by activity from the 1996 MP&M POTW Survey. Average hourly rate from Bureau of Labor Statistics (Sept. 2002 rate, adjusted to \$2001).

Exhibit F.6: Number of Facilities Requiring Additional Permitting	
Option II: NODA/Proposal Option	
Number of facilities operating post-regulation requiring a permit	3,687
<i>Of facilities operating post-regulation:</i>	
existing concentration-based	692
existing mass-based	2,892
no permit in baseline	103
concentration based to be converted to mass-based	0
new concentration-based	103
new mass-based	0
Number of currently permitted facilities closing (no longer requiring a permit)	722
<i>Of facilities closing due to the rule:</i>	
existing concentration-based	209
existing mass-based	513
Option III: Directs + 413 to 433 Upgrade	
Number of facilities operating post-regulation requiring a permit	954
<i>Of facilities operating post-regulation:</i>	
existing concentration-based	184
existing mass-based	770
no permit in baseline	0
concentration based to be converted to mass-based	0
new concentration-based	0
new mass-based	0
Number of currently permitted facilities closing (no longer requiring a permit)	120
<i>Of facilities closing due to the rule:</i>	
existing concentration-based	0
existing mass-based	120
Option IV: Directs + 413+50%LL Upgrade	
Number of facilities operating post-regulation requiring a permit	1,414
<i>Of facilities operating post-regulation:</i>	
existing concentration-based	515
existing mass-based	899
no permit in baseline	0
concentration based to be converted to mass-based	0
new concentration-based	0
new mass-based	0
Number of currently permitted facilities closing (no longer requiring a permit)	120
<i>Of facilities closing due to the rule:</i>	
existing concentration-based	0
existing mass-based	120

Source: U.S. EPA analysis.

Exhibit F.7: POTW Administrative Costs by Option (@ 7% discount rate)

Option II: NODA/Proposal Option

Year Relative to Promulgation of Rule

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Total Hours															
High	32,561	-15,017	-28,095	-60,763	-60,763	-30,038	-30,038	-30,038	-60,763	-60,763	-30,038	-30,038	-30,038	-60,763	-60,763
Medium	33,603	-4,289	-7,680	-14,480	-14,480	-8,335	-8,335	-8,335	-14,480	-14,480	-8,335	-8,335	-8,335	-14,480	-14,480
Low	33,638	-2,472	-4,083	-5,908	-5,908	-4,372	-4,372	-4,372	-5,908	-5,908	-4,372	-4,372	-4,372	-5,908	-5,908
Total Costs															
High	\$990,604	\$-456,868	\$-854,738	\$-1,848,612	\$-1,848,612	\$-913,859	\$-913,859	\$-913,859	\$-1,848,612	\$-1,848,612	\$-913,859	\$-913,859	\$-913,859	\$-1,848,612	\$-1,848,612
Medium	\$1,022,297	\$-130,480	\$-233,655	\$-440,526	\$-440,526	\$-253,575	\$-253,575	\$-253,575	\$-440,526	\$-440,526	\$-253,575	\$-253,575	\$-253,575	\$-440,526	\$-440,526
Low	\$1,023,378	\$-75,221	\$-124,220	\$-179,746	\$-179,746	\$-133,008	\$-133,008	\$-133,008	\$-179,746	\$-179,746	\$-133,008	\$-133,008	\$-133,008	\$-179,746	\$-179,746
	High	Medium	Low												
NPV	\$-9,357,000	\$-1,802,000	\$-422,000												
Annualized Cost	\$-1,027,000	\$-198,000	\$-46,000												
Max One Year Hours	32,561	33,603	33,638												
Max One Year Costs	\$991,000	\$1,022,000	\$1,023,000												

Option III: Directs + 413 to 433 Upgrade

Year Relative to Promulgation of Rule

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Total Hours															
High	33	-2,513	-5,059	-13,011	-13,011	-5,059	-5,059	-5,059	-13,011	-13,011	-5,059	-5,059	-5,059	-13,011	-13,011
Medium	-144	-805	-1,465	-3,055	-3,055	-1,465	-1,465	-1,465	-3,055	-3,055	-1,465	-1,465	-1,465	-3,055	-3,055
Low	-185	-498	-812	-1,209	-1,209	-812	-812	-812	-1,209	-1,209	-812	-812	-812	-1,209	-1,209
Total Costs															
High	\$1,000	\$-76,451	\$-153,901	\$-395,845	\$-395,845	\$-153,901	\$-153,901	\$-153,901	\$-395,845	\$-395,845	\$-153,901	\$-153,901	\$-153,901	\$-395,845	\$-395,845
Medium	\$-4,394	\$-24,479	\$-44,563	\$-92,952	\$-92,952	\$-44,563	\$-44,563	\$-44,563	\$-92,952	\$-92,952	\$-44,563	\$-44,563	\$-44,563	\$-92,952	\$-92,952
Low	\$-5,616	\$-15,154	\$-24,692	\$-36,789	\$-36,789	\$-24,692	\$-24,692	\$-24,692	\$-36,789	\$-36,789	\$-24,692	\$-24,692	\$-24,692	\$-36,789	\$-36,789
	High	Medium	Low												
NPV	\$-1,982,000	\$-509,000	\$-238,000												
Annualized Cost	\$-218,000	\$-56,000	\$-26,000												
Max One Year Hours	33	-144	-185												
Max One Year Costs	\$1,000	\$-4,000	\$-6,000												

Exhibit F.7: POTW Administrative Costs by Option (@ 7% discount rate)

Option IV: Directs + 413+50%LL Upgrade

Year Relative to Promulgation of Rule

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Total Hours															
High	1,566	-980	-3,525	-15,311	-15,311	-3,525	-3,525	-3,525	-15,311	-15,311	-3,525	-3,525	-3,525	-15,311	-15,311
Medium	162	-498	-1,158	-3,515	-3,515	-1,158	-1,158	-1,158	-3,515	-3,515	-1,158	-1,158	-1,158	-3,515	-3,515
Low	-108	-421	-735	-1,324	-1,324	-735	-735	-735	-1,324	-1,324	-735	-735	-735	-1,324	-1,324
Total Costs															
High	\$47,645	\$-29,805	\$-107,256	\$-465,813	\$-465,813	\$-107,256	\$-107,256	\$-107,256	\$-465,813	\$-465,813	\$-107,256	\$-107,256	\$-107,256	\$-465,813	\$-465,813
Medium	\$4,935	\$-15,150	\$-35,234	\$-106,945	\$-106,945	\$-35,234	\$-35,234	\$-35,234	\$-106,945	\$-106,945	\$-35,234	\$-35,234	\$-35,234	\$-106,945	\$-106,945
Low	\$-3,283	\$-12,822	\$-22,360	\$-40,288	\$-40,288	\$-22,360	\$-22,360	\$-22,360	\$-40,288	\$-40,288	\$-22,360	\$-22,360	\$-22,360	\$-40,288	\$-40,288
	High	Medium	Low												
NPV	\$-1,940,000	\$-501,000	\$-236,000												
Annualized Cost	\$-213,000	\$-55,000	\$-26,000												
Max One Year Hours	1,566	162	-108												
Max One Year Costs	\$48,000	\$5,000	\$-3,000												

Source: Estimates of hours by activity from the 1996 MP&M POTW Survey. Average hourly rate from Bureau of Labor Statistics (Sept. 2002 rate, adjusted to \$2001).

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